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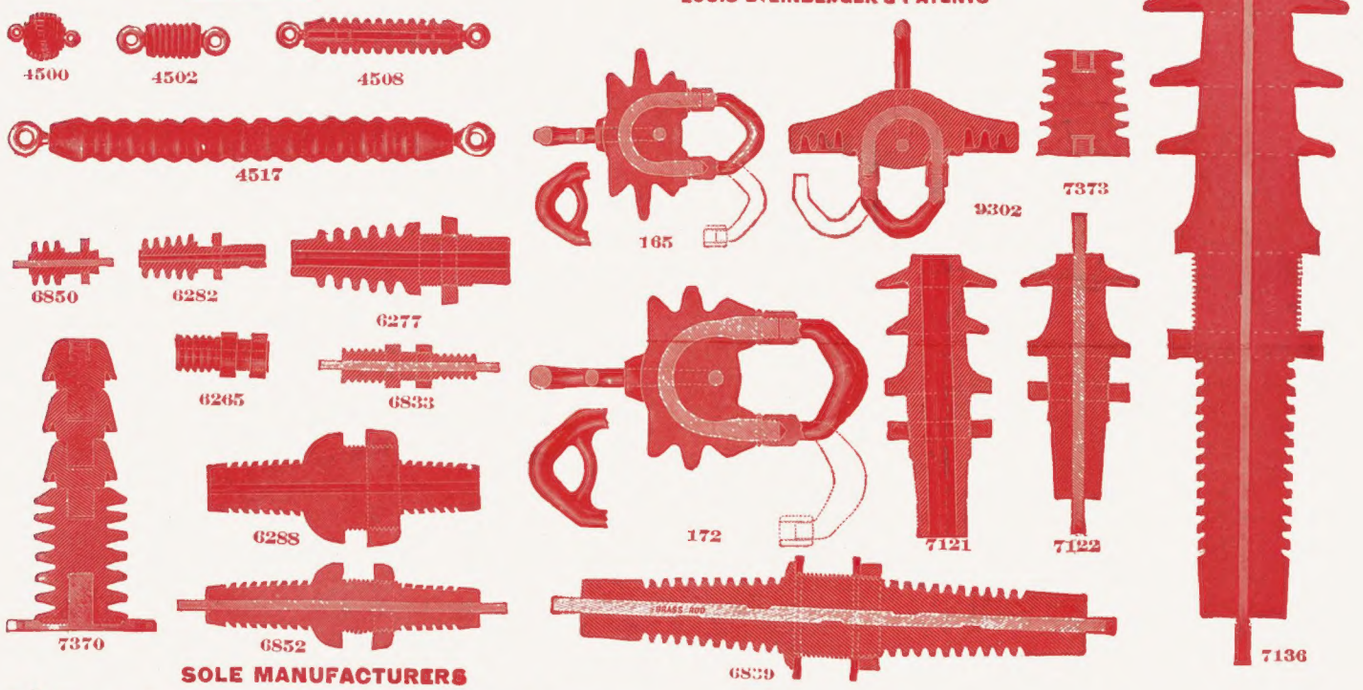

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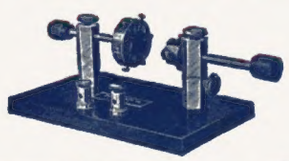

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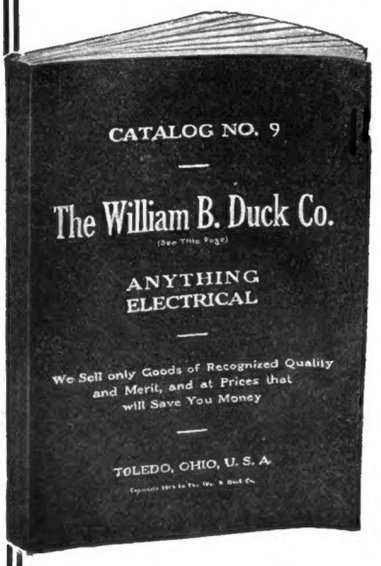
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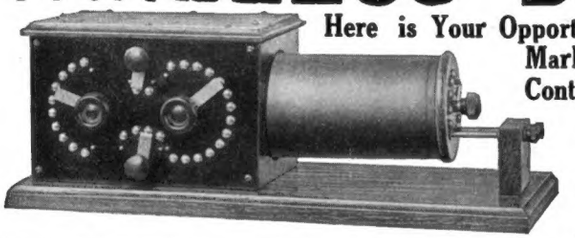

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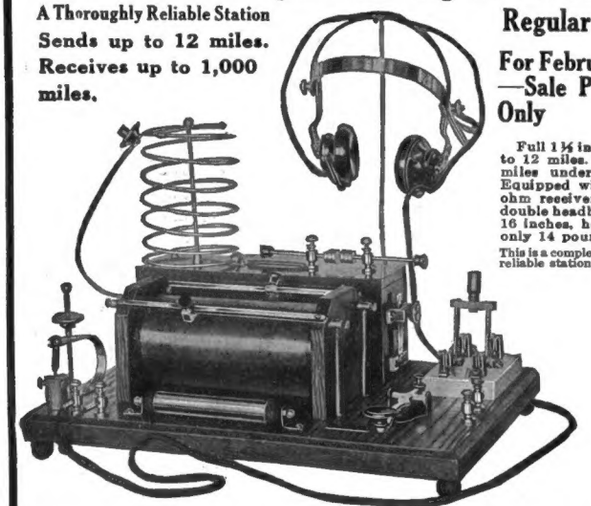

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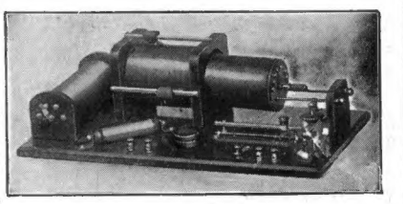

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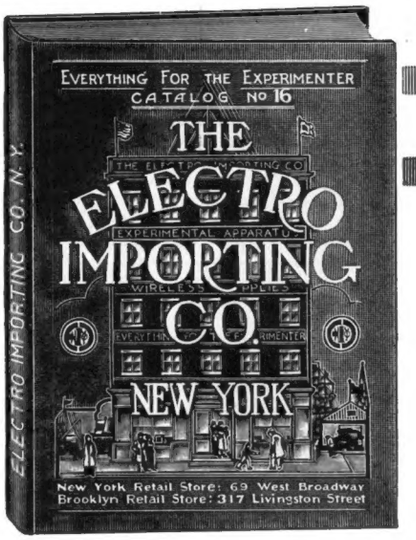

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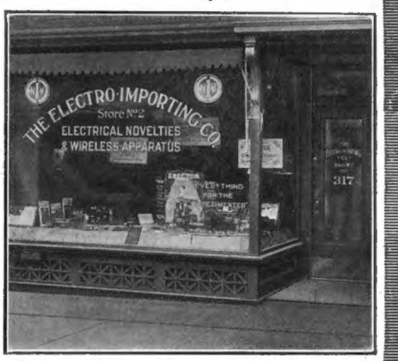

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Forty Years of the Telephone

THE year 1916 marks the fortieth anniversary of the telephone perfected by Alexander Graham Bell in February, 1876, and patented by him on March 7 of the same year.

It is extremely difficult to realize that the instrument which has so revolutionized our every-day lives is but 40 years old, while to our present generation it seems incomprehensible how the world could possibly get along without it prior to 1876. But our fathers and mothers remember full well what inconveniences the daily life beheld before the advent of the uncanny little instrument; they know the drudgery of those days before the slogan, "Don't walk—talk!" had been coined. Forty years back it was "Walk, if you wish to talk!"

Of all the great inventions we know no other which has benefited humanity at large as much as Bell's telephone. Not only does it save us millions of unnecessary steps, but it brings us together closer than ever before. Space has vanished. When the Twentieth Century man of New York calls up his friend in Chicago or in San Francisco, he takes it entirely as a matter of course. He gets married over the 'phone, he calls up the Fire Department by 'phone and thus saves his house from destruction. Or if he is ill he calls up his doctor and is cured over the 'phone. In the course of the day he accomplishes a hundred more remarkable things with the little instrument accessible to the humblest as well as to the richest man. He can accomplish more in a day than either Alexander or Caesar could accomplish in a month, and still he complains of his lot!

As remarkable as the telephone is in its broad field, as remarkable as its career was, so remarkable an exception is it among the great inventions. During the first few years after its appearance it was met with incredulity and derision and Bell, the young struggling inventor, was forced to walk a long path strewn with thorns. It is a matter of history that as wise a man as Senator Platt, of New York, to whom Bell went for financial support, ordered his secretary to "throw that fool Bell with his fool talking machine down the stairs if he calls again." Nor was it encouraging that five minutes after Bell's patent attorney had handed his patent application into the Patent Office, Elisha Gray appeared with a similar patent application at the Patent Office. Few inventions have been subject to more litigation than the telephone, for there were untold millions at stake, but Bell triumphed and his basic patent was upheld by the highest courts. Likewise few inventors have reaped such an immense benefit from their invention as has Bell, nor have many lived to witness such a tremendous as well as universal application of their invention. There is no civilized country on earth where the telephone is not known and used daily; there is hardly a child who does not know what a telephone is. The number of the telephones scattered over the globe reaches in the millions, New York City alone having over 650,000 'phones, or more than London, Paris and Berlin combined!

Most remarkable of all, however, is the surprising fact that the telephone receiver which we use daily is practically the same instrument as the one made in 1876. The shell, the magnets, the coils, the diaphragm are identically the same; 40 years of advance in the electrical arts have left the telephone untouched. Bell's original instrument has not been improved to speak of; his receiver has stood the onslaught of time and brains. Only minor improvements have been made, the construction as a whole remaining the same.

Not only has the telephone found a wide field of usefulness for transmitting speech by wire, but without its use wireless telephony would not be possible. The telephone is used to listen to the criminal's faintest whisper; the European nations at war now use it under water to detect the deadly submarine; the ships at sea with it listen to the tolling of the submarine bell to guide their course in a fog or at night, and we could name a dozen more equally interesting applications of this wonderful little instrument.

When congratulating Bell this year, let us pray that he may live to see the day when some experimenter perfects the so necessary adjunct to the telephone, the *Telephot*, whereby you can see your friend over the wire while talking to him.

H. GERNSBACK.

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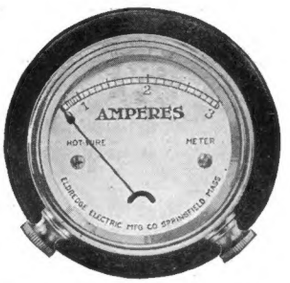

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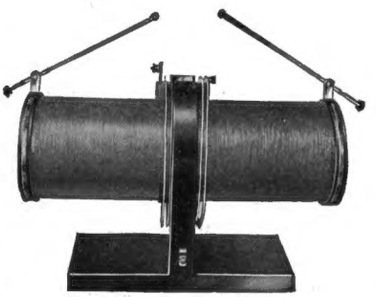

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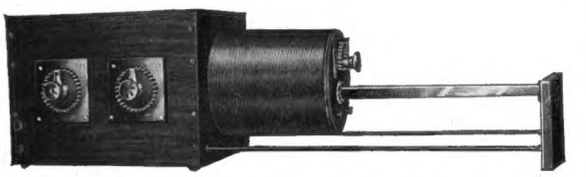

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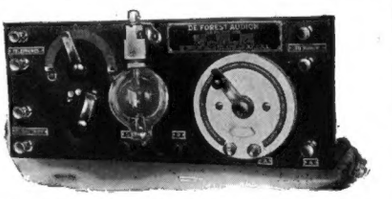

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Vol. III. Whole No. 34 FEBRUARY, 1916 Number 10

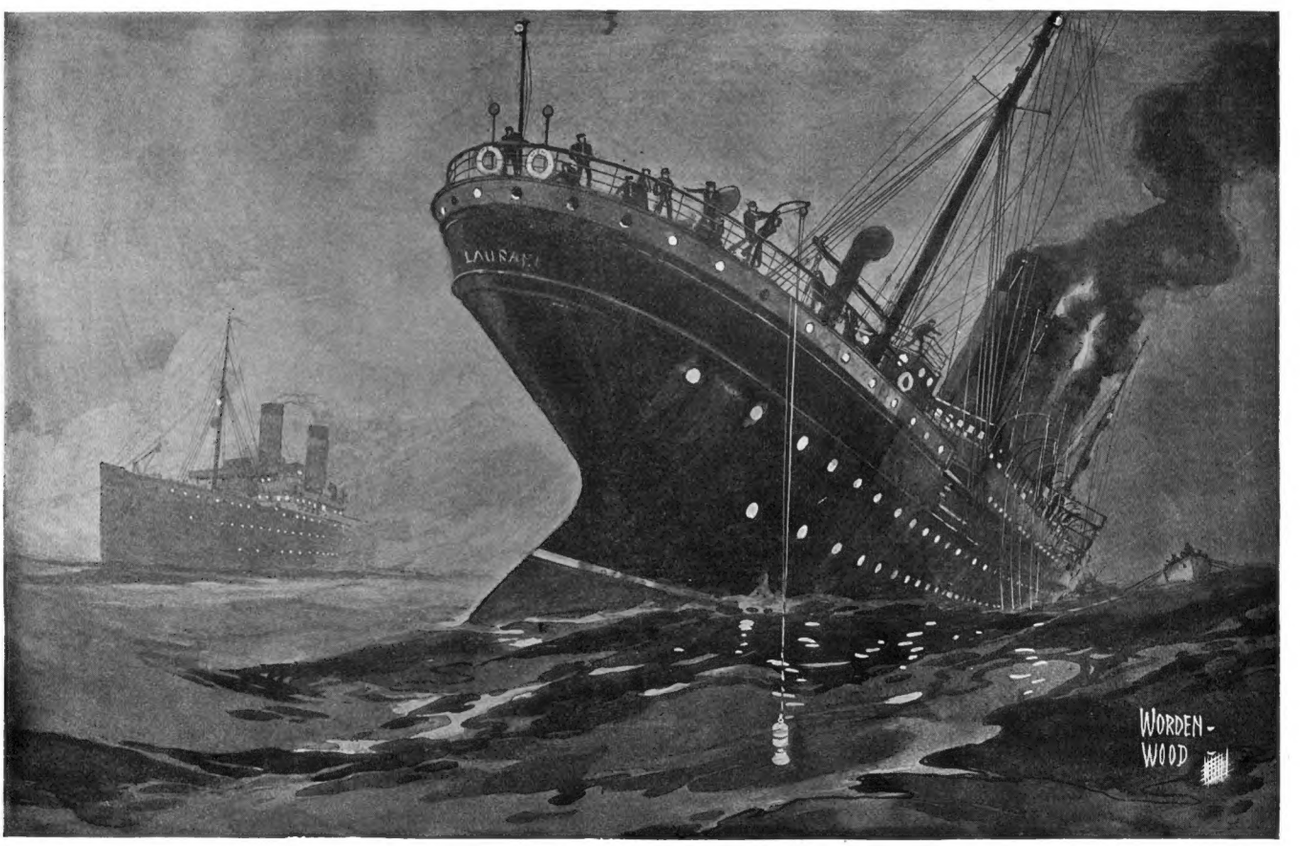
How Vessels at Sea Signal Through the Water

SUBMARINE signaling is a science not very well known to the general public, as little has been published on the subject. However, this method of signaling, utilizing primarily the basic principle that sound waves can be transmitted through water much better than through air, has received extensive patronage both in this country and abroad, especially in the merchant marine. Besides submarine sound wave signaling is of great service to submarine war vessels, for it can be used for inter-communication between ships and between ships and shore stations.

The great scientists Tyndall and Raleigh devoted special attention to the propagation and reception of sound waves in air, but there the matter apparently was dropped until Arthur J. Mundy, of Boston, some years ago, suggested the use of water instead of air as the medium for transmitting such signals through and proceeded to prove its value for such purposes by practical demonstrations.

The advantage of water over air for the transmission of signals are many: In the first place, it is free from the dangerous zones of silence which occur when the signals are produced in air. The absorption of the sound is much less in water, and consequently the signal is not only absolutely reliable but is transmitted to a distance many times greater than when it is transmitted through air. Sounds in the water are not carried away by the wind in stormy weather, as is the case with the Siren. Sound waves through water are not affected by atmospheric disturbances, as is the case with wireless, to some extent at least. Again it permits the accurate determination of the direction from which the sound is proceeding or emanating, which is not the case with any other form of signaling service now available for ships.

Finally the work of Mundy, Wood, Fay, Williams and others working along this line resulted in a completely practical system. The illustrations herewith show some applications of modern submarine signaling, as well as the bell and indicator used in this remarkable system of intelligence transmission and reception.



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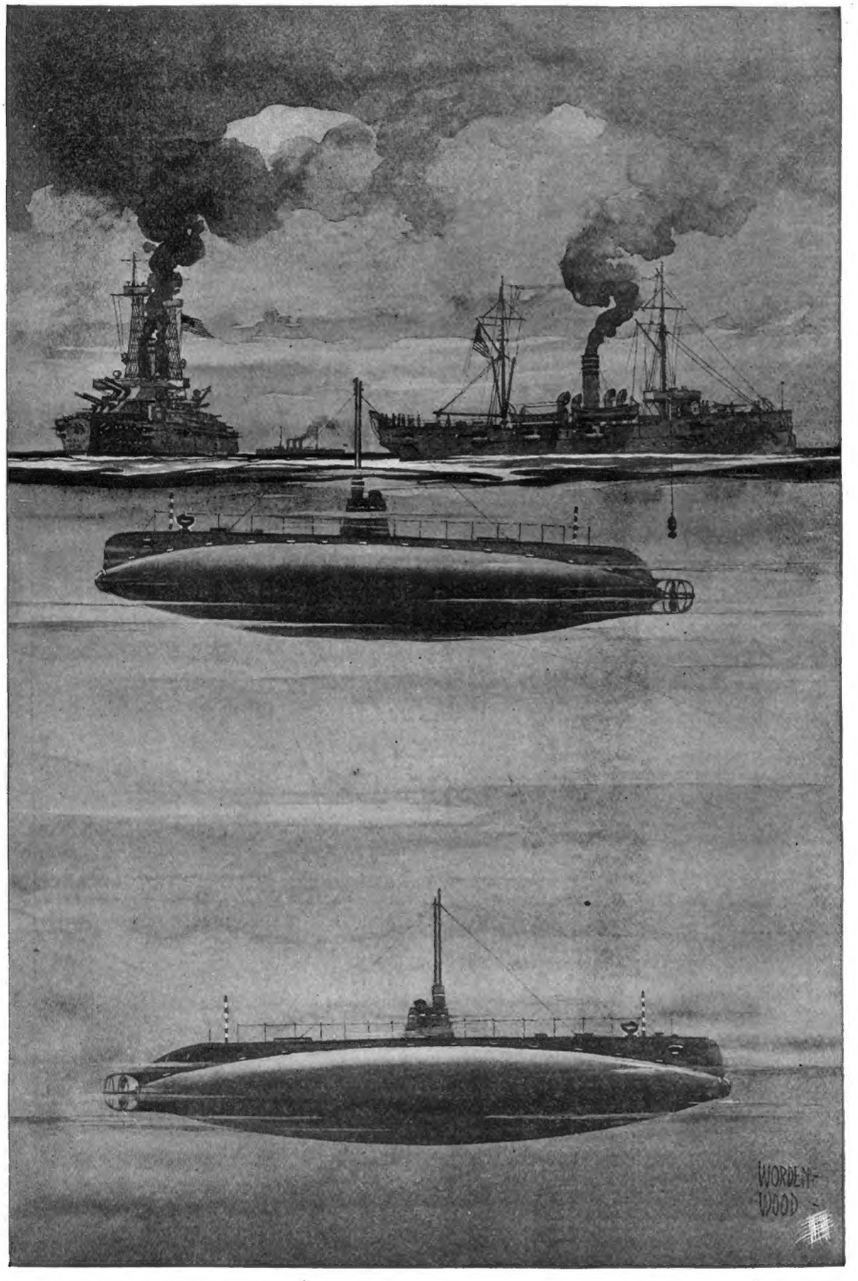
Sinking Liner Found in Fog by Submarine Signaling Bell.

The sound waves as used in submarine telegraphy are set up by one or more compressed air or electro-magnetically actuated sound disseminators, one of which is illustrated herewith in Fig. 1. This transmitter consists of a 220-pound bell, about 15 inches in diameter, attached to a case containing the actuating mechanism. This is of simple construction. It comprises a large electro-magnet which attracts a disc-shaped armature. This in turn is attached directly

to the rod which moves the hammer of the bell. The bell may be suspended from a cable over the side of the ship as one of the larger illustrations indicates, or in case it is used along the shore, it may be suspended from a tripod resting on the bed of the harbor or ocean. The tripod in such cases is made of steel channel beams and stands about 21 feet high. A waterproof cable leads from the electric bell to the shore station which is generally located in a lighthouse, for in this way the attendant can cause the bell to give out its note as desired, either continuously as a warning signal against fog, or in short and long strokes as in sending a message by the Morse code.



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Submarines and Another Ship Maneuvering by Submarine Signals.

The sound waves thus transmitted through the water (at the rate of aproximately 4,400 feet per second) are picked up or received by a supersensitive microphone. It has been found best to mount this in a separate tank secured to the side of the vessel below the water-line. The microphone is thus suspended so that the noise due to the machinery on board the ship and the water noises will be eliminated. One of these microphone tanks is mounted on each side of the bow, inside of the ship. From each tank wires are run to a device which is known as the indicator box, shown in Fig. 2. This comprises a switch so arranged that by throwing the handle to one side the starboard microphone is connected to the telephone and by throwing the handle to the other side the port microphone is connected to he telephone receiver. These receivers are furnished in duplicate. Thus it is obvious that once the bell signal is picked up the captain of the vessel has only to turn his vessel until the sound is heard with equal intensity on each side to know that his ship is then pointing in the direction from which the sound is coming, and in this way he can take compass bearings of the lightship on which the bell is situated, if such happens to be the source from which the signals emanate.

The transmission or reproduction of speech by hydrostatic waves would seem feasible and has become possible indeed through the use of later developments along this line, principally those of Prof. R. A. Fessenden, of wireless fame. He employs for the purpose what is termed an "oscillator." Its construction is shown in Fig. 3. In this sectional view the iron of the magnetic circuit and the copper tube are shaded and the magnetizing coil is cross-hatched. The copper tube is at A, which lies in the air gap of a magnetic field formed by a powerful ring magnet B, built up in two parts, as perceived. The ring magnet is energized by the coil C, and produces an intense magnetic flux across the air gap containing the upper part of the copper tube, thence through the central stationary armature D, thence across the other gap to the lower pole face of the ring magnet and thence through the yoke of the ring magnet back to the upper pole face. Around the armature is wound a fixed winding, known as the armature winding, and which is reversed in direction, so that one-half of same is wound clockwise and the other counter clockwise.

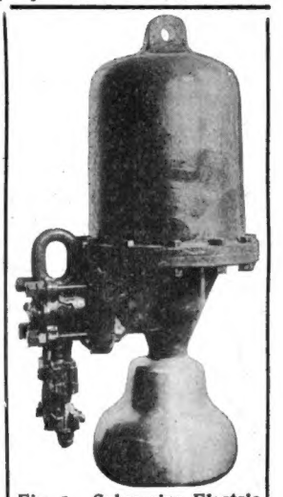


Fig. 1. Submarine Electric Bell.

When the alternating current is passed through this armature winding, it induces another alternating current in the copper tube. Only by this construction, it is said, has it been found possible to obtain the enormous force necessary to rapidly compress the water and thus make possible the rapid transmission of telegraphic signals through this medium, as well also as telephonic transmission.

Further, in order to apply this force now set up, an electro-magnetic reaction is started. In other words, to transmute this force into wave compression in the water, the copper tube is attached to solid discs of steel, which in turn are attached to a steel diaphragm one inch thick, which may be made a part of the vessel. In practise the tube is provided with lugs and is held be-

Fig. 2. Indicator Box for Submarine Signaling.

(*Continued on page* 586.)

New Searchlights Foil the Enemy's Guns

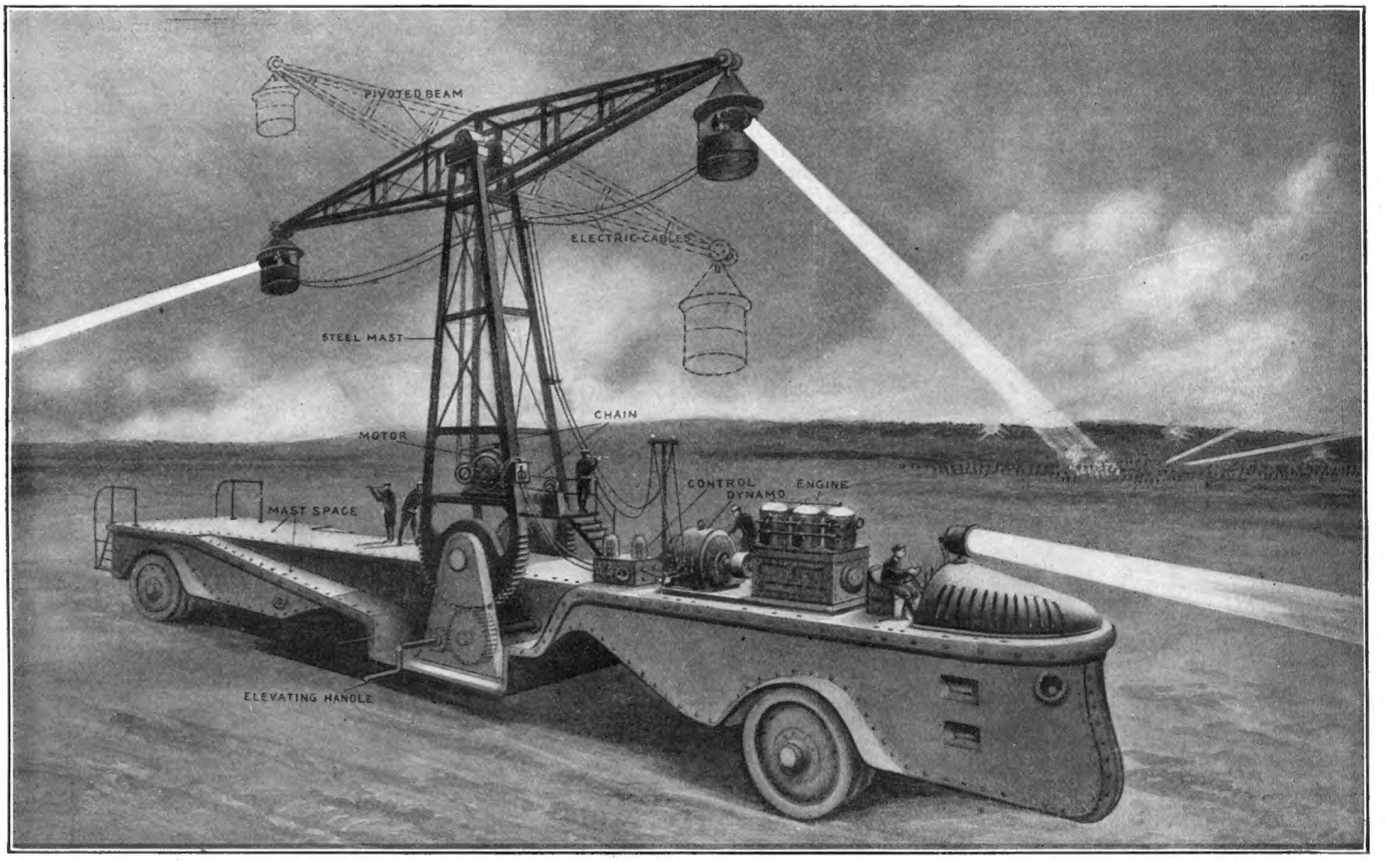
IN the illustration herewith is perceived a somewhat novel form of searchlight mounted on a rapidly movable or oscillating arm, which in turn is carried by a powerful motor truck so as to be very mobile and thus readily transported from place to place as required. This idea has been brought forth by H. Gernsback.

As is quite well known, a fixed searchlight, such as now used by the great European armies, becomes very quickly a target for missiles of all sizes and descriptions, which, needless to say, soon reduce it to a scrap heap. The gun spotters of today even those in charge of large caliber field pieces, are notoriously accurate in their work, and unless a searchlight which is visible to them is constantly moved it is bound to be the unhappy target for a host of high explosive shells before many peaceful moments have passed.

To obviate these and other untoward difficulties surrounding the use of searchlights in night-time warfare, this design has been promulgated, and, as may be gleaned from the illustration, it is intended to use one or both searchlight beams at the same time. The motor truck of large size carries a complete dynamo and gasoline engine for running same, which is seen mounted behind the driver's seat on the truck. By means of heavy flexible cables from the dynamo the searchlights, which are carried in small cases when not in use, are supplied with current. When being used the projectors are constantly oscillated or moved up and down at an ever-changing speed. This is obtained by a hand crank, which is shown in the illustration.

However, it is possible to also effect this irregular up and down movement of the horizontal girder carrying the searchlight baskets by means of electricity. The electric control box for this arrangement is indicated on the truck. Such a mechanism may consist principally of a motor-driven drum having on its surface a considerable number of segments making contact with a pair of brushes. To every pair of segments on the drum there can be joined a different resistance, so that as the drum is rotated it will cause differing values of current to be supplied to the motor on the main pedestal, which in turn controls the up and down movement of the horizontal searchlight girder.

It is also very easy to arrange reverse current trips on the device just mentioned, so that the arm will move downward so many degrees and then reverse and move upward so many degrees. If desired, this arrangement may be modified in many ways so as to be adapted to stationary requirements. In such an event the truck could be made many times larger, most probably to advantage. Again, the center pedestal carrying the constantly moving horizontal arm could be swung about on its vertical axis so as to give greater play to the searchlights and also simultaneously to make them a more difficult target for the enemy's gunners. The dotted lines in the illustration show a second position of the horizontal girder carrying the searchlight baskets. It is thought that the constantly moving searchlights of this type are practically proof against the enemy's fire, as it would be impossible to accurately train a gun on them. However, it remains for such a device to be actually tried out before we can predict the results.



Remarkable Mobile Searchlight Tractor Designed to Keep the Searchlights Constantly Moving, Vertically as Well as Horizontally. A Difficult Target for the Enemy.

PROFESSOR ULIVI OUTDONE IN AMERICA?

Professor Montraville M. Wood, of Chicago, who spoke in Paul Revere Hall at Boston, recently, outdid Giulio Ulivi's claims for his F-rays in claims for the ultra-violet rays, which appear to be the same thing. According, however, to Professor Wood, the naval advisory board is in possession of "the secret of the ultra-violet ray" and the wonderful power it controls, and is conducting experiments with it, and he predicts that within a short time the turret guns of the ships of the United States will be operated automatically by the use of the ultra-violet ray, and that the guns will not fire until they are in a direct line with the object at which they are aimed. Men, except to load the guns, will not be needed.

In regard to the employment of time fuses in the starting of fires on board the ships carrying supplies, the professor says, what really happens is that someone, either off shore or on the ship, conceals a carefully tuned Hertzian ring in a lump of coal, and closes the cup, or gap, with a piece of guncotton. The ship sails, gets as far as mid-ocean. There is a sudden explosion, followed by fire. An operator on shore fired that ship, either by tuning his wireless coil until he reached the proper wave, or by bringing the ring in focus with the ultra-violet ray, or so the professor thinks.

DETECTS THUNDER STORMS 300 MILES AWAY.

Using a modified wireless receiving instrument, a French scientist has been able to detect thunder storms more than 300 miles distant.

The Trench Tractor

By H. Gernsback

BEFORE the advent of the monstrous 14-inch field guns, it was thought impossible to take a well-manned fortress by the then existing means. But since we have learned that the strongest fortress can be reduced within a few hours to a mere scrap heap it has become necessary to keep the enemy so far away from the fortress that his guns cannot reach it.

So the curious paradox has come to pass, as witnessed in the great war, that concrete and steel fortresses are protected no longer by stone or steel walls, but by human flesh sheltered by trenches.

Once two contending armies dig themselves in trenches, these armies practically cease to exist for their respective countries. They become deadlocked and up to this time, as the European war demonstrates so clearly, nothing has been invented whereby one army can effectively drive the other from their trenches. For over eighteen months at this time of writing the Germans and the French have been deadlocked, neither contending army having moved forward or backward for more than five miles. To be sure, local successes occur here and there and sometimes one or the other carries a few hundred yards of trenches only to lose them the next day.

The Germans being the first to realize the unsatisfactory results of trench warfare set out to devise some means to drive the enemy from his trenches. We are all familiar with the result whereby poisonous or asphyxiating gases were used. This plan worked well for a time till the enemy learned to wear respirators, and it is now a rare occurrence that a trench is won by means of gases alone.

What is needed to-day is a machine to effectually combat the men in the trenches by either destroying them or otherwise putting them out of action. This must be accomplished with great rapidity in order to quickly repeat the operations with the second and the third line of trenches. Then when a successful gap has been made, it will be a comparatively simple matter for the men to rush up into the break and *"consolidate"* the new advanced positions, as the French term this process.

The writer desires to advance a new idea by which to accomplish the foregoing, and while it may appear fantastic at first thought it is nevertheless not an impossibility. We need but remind the incredulous that but eighteen months ago the wisest military engineers outside of Germany would have laughed at the idea of running a 14-inch 140 ton gun over land. It was accomplished, nevertheless.

While the Trench Tractor as conceived by the writer is of course purely imaginary, we are not at all sure that a machine of this type will not roll over the ground in the not very distant future.

Briefly, the Trench Tractor is a huge two-wheeled monster, propelled by electricity and of sufficient size to "walk" over ordinary trenches with ease.

The imaginary tractor, as shown in our illustration, has two wheels, each 40 feet high and 15 feet wide. The business part of the machine is about 70 feet long and about 15 feet square. In it are carried 200 fully armed men, bomb throwers, a number of 3-inch and 6-inch guns, as well as machine guns, ammunition stores, supplies, wireless apparatus, a steam generating plant, the two power plants, etc., etc. The tractor is to run at a speed of about 20 miles and is estimated to weigh 10,000 tons. It is needless to say that the body of the machine is armored with a heavy plating so as to protect the men in the interior from the enemy's shell fire.

At first thought one would imagine that such a huge machine requires an enormous amount of power to move it at a speed of 20 miles an hour, but this is not the case. Moving over level ground but 2,600 horsepower are required, which is but 2,000 kw. The average electric train of 3,000 tons requires 605 kw. to move it at 20 miles an hour.

Thus our imaginary tractor, to run over rough ground or to ascend hills (in a zigzag line) would not require over 3,500 horsepower at the utmost. This is very much less than is used by a moderate-sized steamship.

The right wheel, which shows the detail of the motor which propels the former, is illustrated with the plating broken away to show the interior; both wheels, however, are of course heavily plated with armor to protect the motors.

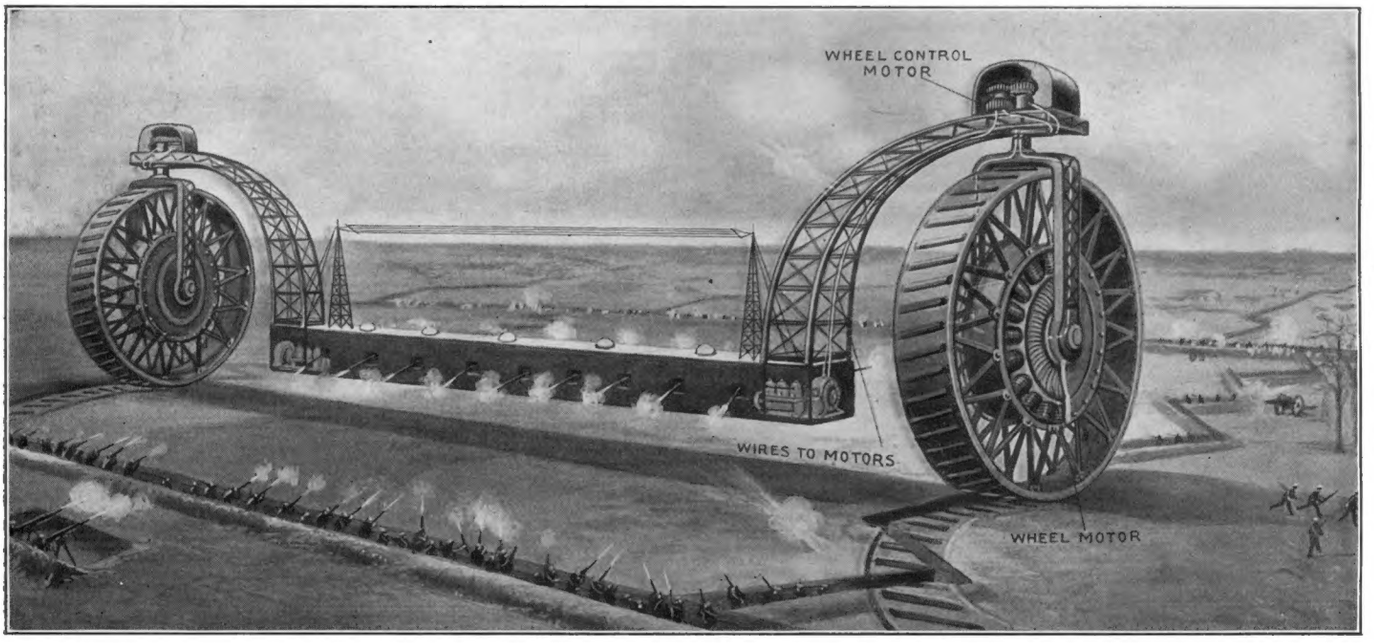
Two independent high speed gasoline or oil engines are used to drive the dynamos, which in turn supply the current to the slow running wheel motors. As the wheels are so large they need but run at 14 revolutions per minute in order to drive the tractor at a speed of 20 miles per hour. For this, and other self-apparent reasons, the electric mode of propelling the machine is necessary.

In the illustration the tractor is shown running with its wheels parallel to each other. This is the fighting position. As the length of the entire machine, measured from one side of one wheel to the other is over 140 feet, the tractor could not of course run on a road. For this and other reasons the wheels can be turned about, bicycle fashion, so that the machine can run lengthwise. In this position it measures but 18 feet wide and it will roll comfortably on a road and even over a steel bridge. In this position also it offers but small surface to the enemy's fire.

The body of the tractor swings about 10 feet above the ground, and as our illustration shows the machine has just run over the enemy's first trench. It therefore *attacks him in the rear.* In a few minutes the men from the tractor's regiment trenches will rush up and the enemy *will be under fire from two sides.* The enemy is overpowered while the tractor rolls over the second trench and repeats the operation there, and so on if other trenches are left. A less bloody variation of this may be had when the tractor stops right above the enemy's trench. By means of its steam plant live steam in great quantities may be let loose on the men in the trench below, and this method presents several advantages.

First, it is a very powerful argument to

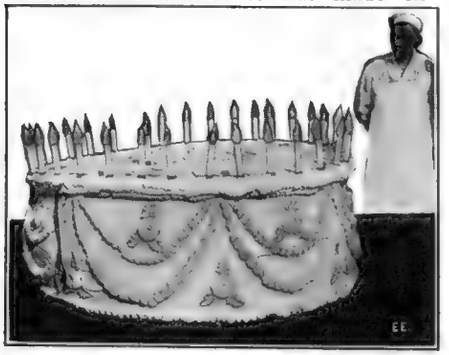
(*Continued on page* 587.)



A Powerful Land Fighting Machine That Can Travel Sidewise or Longitudinally. It is Capable of Carrying Heavy Guns as Well as Rapid Fire Machine Guns.

MAMMOTH ELECTRICALLY DECORATED BIRTHDAY CAKE.

What is claimed to have been the largest birthday cake ever baked is shown in the illustration herewith. It was made expressly for the 35th anniversary of a large department store in Columbus, O. It weighed nearly half a ton and required eight husky men to lift it. The dimensions were 4½ feet wide and 15 feet in circumference. It comprised nine toothsome layers, which were cut up after the celebration, so that each of the 15,000 visitors to the store received a choice morsel. The mayor of Columbus had the honor of cutting the cake.



Electrically Decorated Birthday Cake That Weighed Nearly Half a Ton.

The ring of electric candles incorporated in the design of this huge layer cake was composed of a galvanized sheet iron ring 54 inches in diameter and 3 inches wide, with a groove pressed in the center to the depth of ¾ inch. Wires were placed in the groove and secured therein with the candle top terminals projecting upward. The sockets for the candle bulbs were attached to these wires and the porcelain shields completed the make-up, with the result here observed. The lamps were lighted from a 110-volt D. C. circuit, and in finishing the cake the ring with its attached lamps was placed upon same and then the frosting and pastry decorations were covered over the whole affair, so that neither the ring nor the wiring were visible at any place.

WINDING YOUR WATCH BY MOTOR.

Does the average man stop to realize the amount of energy required to wind his watch? It would be noticeable, however, indeed if he had to wind 700 watches every day. The winding of this number of timepieces became quite an important problem in a concern testing and repairing a large number of watches.

We have all heard of how Edison wound his watch by holding the stem of it against the guide in the elevator shaft, but it is quite impossible to use this method for winding 700 watches. Therefore the machine illustrated here was devised.

This Device Winds 700 Watches Daily.

This apparatus consists of an electric motor driving a shaft by means of a large friction pulley shown on the right. At the near end of the shaft is a small socket lined with felt which engages the stem of the watch. The only thing necessary for the watchmaker to do is to start the motor and hold the stem of the watch against the felt-lined socket.

As soon as the watch is completely wound, the tightened spring overcomes the friction between the motor shaft and the socket shaft. The spring is not wound tight enough to break it.

By this means watches can be wound very quickly and, in fact, this machine now does the work that previously required the services of several persons. Photo courtesy of New York Edison Co.

Gigantic Gas-Electric Locomotive

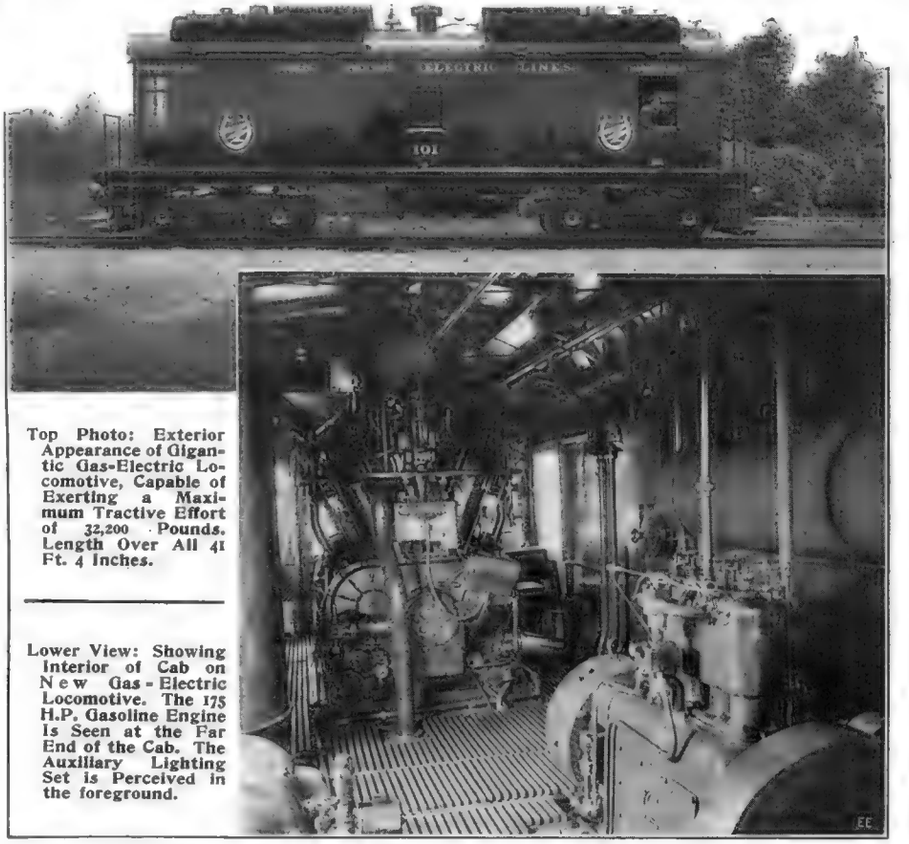
One of the largest electric traction corporations in the Middle West, which operates the "Dan Patch" electric lines, has recently received as an addition to its rolling stock three gigantic 60-ton gas-electric locomotives for improving its freight, passenger and terminal service.

These gigantic hybrid moguls were built by the General Electric Company. Their general external and internal appearance may be observed from the illustrations herewith. This electric traction road is said to be the first system of its kind in the world to be operated entirely by gas-electric service. One of the longest runs on this line is 107 miles.

The new 60-ton gas-electric locomotive here illustrated is of the double ended type and is built with the box type cab extending nearly the entire length of the underframe, with all the weight placed on the drivers. One engineer only is required to operate this locomotive, and it is claimed to be much more flexible in its control features and other characteristics than any other form of prime mover intended for railway purposes. The electrical generating equipment consists of a 175-horsepower, 550-r. p. m., 8-cylinder, 4-cycle gasoline engine of the "V" type. This is direct connected to a 600-volt, commutating pole, compound wound electric generator. Ignition of the engine is accomplished with low tension magnetos and the sets are started by compressed air. After starting one of these sets, of which there are two in each locomotive, the second set may be accelerated and brought up to operating speed electrically from the other set.

A very good feature in such designs as this, which marks a great step forward in locomotive evolution, is that the engines may rotate at normal speed irrespective of the speed of the locomotive and deliver their maximum power, which is a feature of great advantage on grades, in the case of snowstorms or other emergency conditions involving sudden, heavy current demands. There is an auxiliary gas-electric set which furnishes power for lighting the cab, headlights and train coaches.

The locomotives are propelled by means of four 100-horsepower electric motors of the commutating pole type. All four axles are therefore driving axles. The motors are ventilated by a special vacuum system in conjunction with the engines. These engines are capable of exerting a maximum tractive effort of 32,200 pounds. The length over all is 41 feet 4 inches and height over all 14 feet 10¾ inches, with an over all width of 10 feet 2 inches.



Top Photo: Exterior Appearance of Gigantic Gas-Electric Locomotive, Capable of Exerting a Maximum Tractive Effort of 32,200 Pounds. Length Over All 41 Ft. 4 Inches.

Lower View: Showing Interior of Cab on New Gas-Electric Locomotive. The 175 H.P. Gasoline Engine Is Seen at the Far End of the Cab. The Auxiliary Lighting Set is Perceived in the foreground.

The largest electric hoist in the United States has been installed in a mine in Butte, Mont. The new machine hoists at a speed of 3,000 feet per minute and can lift 14,000 pounds up a shaft 4,000 feet deep.

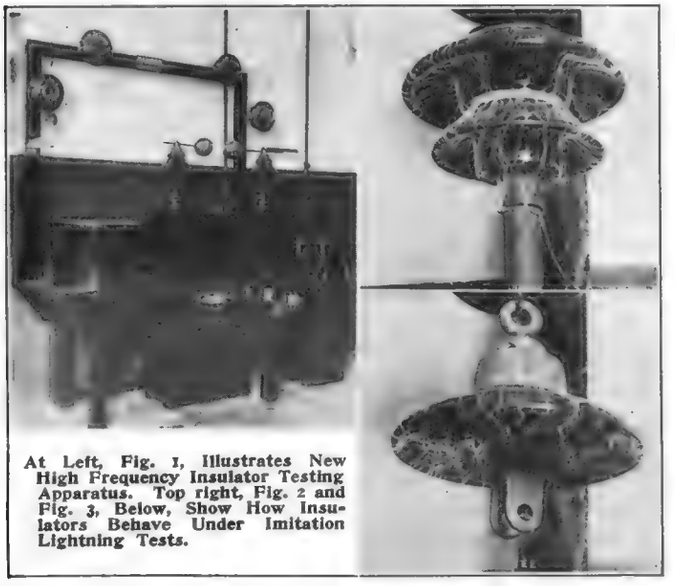
TESTING INSULATORS UNDER "LIGHTNING" CONDITIONS.

It has been common for many years to test insulators, particularly those intended for high voltage line work, at a potential of several times the normal working value at which the insulator is to be rated.

In the illustrations herewith Fig. 1 shows a special testing outfit as used by the Georgia Railway & Power Co., of Atlanta, Ga. These illustrations are reproduced through the courtesy of E. P. Peck, in charge of the testing department of that corporation. It has been definitely asserted that even when these insulators have been tested at four or five times the working line voltage on which they are to be operated normally that they would often and repeatedly fail for no apparent reason when the voltage piercing the insulator was known to be not more than one and one-half times the normal potential. It has been definitely deduced that the reason why the insulators fail in the manner just described is because of some high frequency disturbance on the line, as lightning, which has caused the insulators to be thus punctured. Lightning, of course, is a high frequency current invariably, and to imitate these conditions as nearly as possible has been the work of recent years of the foremost testing engineers.

The apparatus here illustrated comprises a high voltage step-up transformer, calibrated spark gap, together with oil immersed condenser, etc., arranged somewhat after the fashion of wireless transmitting sets for producing high frequency oscillations. The set here shown can be run up to 300,000 volts at 200,000 cycles. This apparatus is arranged so that the voltage may be increased by steps of a few thousand at a time and thus a considerable testing range is at the command of the engineer in charge.

Figs. 2 and 3 graphically illustrate the effect produced on the high voltage insulator as the current finally leaps over the surface when the voltage has been increased above the normal working value. Fig. 2 shows how the sparks have traversed up under and on both petticoats of the insulator; one high voltage terminal being connected to the pin supporting the insulator, while the second high tension terminal is mounted on top of the insulator. This method has been favorably received and considered by the best engineers in the country, and undoubtedly the time will shortly arrive when all transmission line insulators at least will be tested by this method, as in no other way can the effects produced by lightning be duplicated.



At Left, Fig. 1, Illustrates New High Frequency Insulator Testing Apparatus. Top right, Fig. 2 and Fig. 3, Below, Show How Insulators Behave Under Imitation Lightning Tests.

English Women Learn Wireless

The great European war has made possible the impossible and bids fair to change all the familiar landmarks and aspects with which the globe trotter is more or less familiar. For one thing, the women of Europe have taken up practically every branch of human endeavor, including the trades and professions.

The illustrations herewith show how the English women are taught wireless telegraphy. The upper view shows the principal and a portion of the class in the East London Wireless College located at Forest Gate. These students are members of the Women Signalers' Territorial Corps. All the apparatus has been loaned by the Marconi Wireless Telegraph Co. In the lower illustration one of their multiple tuners with a magnetic detector is seen. A diagram of an oscillatory circuit is seen on the blackboard.

The young ladies are said to be very adept at picking up the wireless code and evidently mean to do their full share in the war's work whenever necessary. The women in France have taken the place of the men in practically every branch of science and industrial work. Practically all the street car motormen's and conductors' positions have been substituted by women and all the telegraph and telephone positions are said to be filled by them in a completely satisfactory manner. How these fair devotees of the radio art intend to climb aerial masts to make repairs, etc., cable reports fail to state, but we presume it is taken for granted that there will always be a man around some place to do such stunts.

At Left: Class of Enthusiastic Girl Students in the East London Wireless College. They Are Members of The Woman Signalers' Territorial Corps.

At Right: A View of the Women's Radio Class at Close Range. Here We See Them Actually Receiving Radio Messages on Commercial Type Instruments. Oh, Yes, They Understand Diagrams. Note Blackboard.

NEW USES FOR VACUUM CLEANERS.

Vacuum cleaners are used to keep pool tables clean and to remove loose hair from freshly groomed horses. By grooming the horses electrically they are given a better appearance and there is no loose hair to get on the clothes.

SIGNS THAT TIMES HAVE CHANGED.

There are hundreds of families in every city that are still denying themselves the comforts and conveniences of our modern mode of living just because they have never worked out the proper answer to the question, "Can we afford it?" They have inherited the belief that electricity in the home means an expense that can be afforded only by the well to do. There are now many homes where the monthly bill for electric current in mid-winter does not exceed the cost of one roast of beef. They use the electric fan in summer, an electric heat pad in winter and electric suction sweeper each week, and the bill varies from $1.50 in June to $2.50 in December. Why not give the electric current a trial?

Miniature Electric Battleship "Massachusetts"

By Carrol Wakeman

A WONDERFUL electrical working model of the United States battleship Massachusetts, which took two and a half years to construct, has been recently placed on exhibition. It was built by Samuel Orkin, who labored on it an average of 16½ hours a day. This most remarkable little craft is built entirely of steel, and after setting the automatic timing device runs entirely alone. She is capable of running at a speed of 14 knots an hour for six hours, or will tow three men in a canoe at the rate of eight miles per hour. It carries 12 miniature 14-inch guns, 12 six-inch guns, four rapid-firing and two aeroplane guns, also six torpedo tubes. It is 13 feet long and two feet in breadth, having a displacement of 750 pounds and a draft of 9½ inches. She is manned by a dummy crew, which, in accordance with the size of the ship, are three inches in height. There are two derricks, which lift the miniature steam launches and swing them over the side into the water, where they run for 15 minutes entirely independent of the mother ship. The vessel is run by nine motors, three of which revolve the three propellers; the main motor developing one horsepower. The motors receive their current from specially designed storage batteries, having a capacity of 72 amperes. The portholes have lenses; but, should any water get into the hull of the ship, it would be forced out by pumps working automatically every five minutes. A rudder which has a resistance of 50 pounds steers the ship automatically in any direction.

When the automatic device is released, and the various motors commence to work, magic is out-wondered. Suddenly the clash of a miniature band playing "The Star-Spangled Banner" rings out, and as the flags are hoisted slowly signal lights begin to flash in the fighting masts, real wireless messages are being sent, miniature metal sailors run along the decks, opening the doors and shutting them, saluting exactly as though they were human. They climb the shrouded ladders and begin to operate the 12 searchlights, throwing the powerful rays in all directions, at the same time elevating them at all angles.

Then you gaze in wonder! Sharp sparks of real wireless messages are sent out, signal lights are flashing Morse code to other imaginary ships, and did you know the code you would ascertain that the officers of the dreadnought are flashing orders to other ships to fall into double battle line.

The doors in the superstructure of the ship swing open, and over 200 bluejackets, running from all parts of the deck, disappear through them into the heart of the vessel.

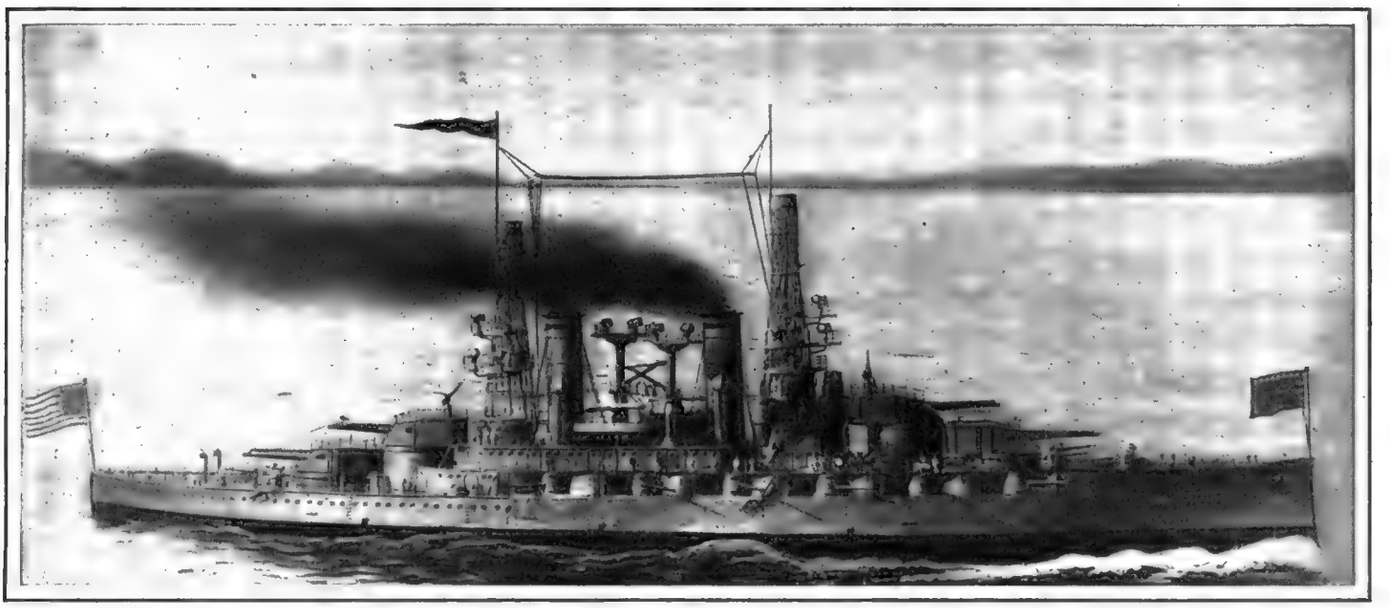
Suddenly an order is given, the siren whistle signals to clear the harbor, and anchors are hoisted automatically. The propellers begin to revolve and the rudder turns in response to the steering levers operated by the officer on the bridge, and this mighty engine of destruction is under way.

With her decks cleared for action and her crew below, all save the little group clustered around her commanding officer, you see her steaming away with a trail of smoke belching from her smokestacks. As she is maneuvering, the lower of the superimposed turrets swing to the right and a puff of smoke leaps from one of them.

Instantly the next gun speaks, and the next. When the turrets swing again, this time to the left and a full broadside is fired, the report is tremendous from all 12 guns.

Now the after turrets are taking up the cannonade, shooting their spirals of smoke far out and filling the air with the smell of powder. Next, the warship draws closer to the imaginary enemy, the smaller guns in the broadside batteries—the six-inch guns—come into action, swinging to a new angle at each shot.

When the supposed enemy has been sunk the battleship slows down in speed. The doors in the superstructure open again and her ship's company pour out again. The boat is steered automatically to the shore, wireless messages being sent to the victorious sailors. (The boat is steered automatically to the shore.) The band strikes up "The American Patrol," the siren shrieks, to clear her path, sailors marching, flags hoisting up. Gradually the ship draws near the shore, the band stops playing, the sailors enter the cabins and the boat becomes motionless. As the automatic devices have stopped, it would take but a minute to repeat the same or send her in another direction. Mr. Orkin intends to build next a complete fleet of boats having submarines, torpedo boats, aeroplanes, et cetera. Then a genuine sea battle in replica can be faithfully staged, giving a most wonderful sight.



A Replica of the U. S. Battleship "Massachusetts" in Miniature. It Measures 13 Feet Long and by Means of Electricity Fires Guns, Flashes Searchlights, Signals by Radio, Etc., Most Realistically.

WAR EXTENDS APPLICATION OF WIRELESS.

France has about 10 wireless stations, the most powerful being the Eiffel Tower. The Germans have a great many more, especially the big station at Nauen, with the transmitting power occasionally raised up to 7,200 miles. They have a similar post in Spain, and until recently operated directly from Sayville, L. I. The latter plant is now in the hands of the United States Government, and German operators are not permitted to dispatch messages. The Sayville plant apparatus was made in Germany.

When the cables connecting America and Germany were cut the great wireless system in nowise impaired Teutonic communications directly with the United States. It has been shown that the power of the German wave from this station paralyzed almost entirely all other wireless communications. It is said that as much as 90 per cent. of the successes of the Germans in offense and in escapes have been due to their innumerable wireless stations.

GERMANS TAKE CABLES FOR COPPER.

Abandonment of little-used cable on street car lines, so that the copper may be obtained for war purposes, has been ordered by the municipality of Kiel, Germany, according to a Reuter dispatch from Copenhagen, which says that the work of tearing up three streets for this purpose has begun, and that about 3,000 yards of cable, weighing approximately seven tons, will thus be available.

Other lines are expected to be similarly treated in Kiel and other German cities.

The Modern Detecta-Phone

By Samuel Cohen

THE Detecta-Phone is an instrument for use whenever secret reporting of a conversation may be necessary. It is also used in aiding partially deaf people to hear. This instrument is so sensitive that the speaker may sit at a distance from the 'phone of 10 or more feet and the detective can hear the conversation accurately.

In detective work the transmitter of this apparatus may be concealed in any section of the apartment, such as in drawers of desks, in the walls, behind pictures, etc., and yet a voice in the room is accurately reproduced at the receiving end.

The Detecta-Phone comes under the class of electric devices commonly called "dictographs." They consist essentially of a supersensitive microphonic transmitter, made up of a large number of minute carbon balls (not grains) contained in a cup made of the same material and a thin carbon diaphragm resting against these balls. These parts are enclosed in a metallic case and are properly adjusted. The transmitter is connected in series with a battery and telephone receiver, which latter is of the low-resistance type, and the instrument described here employs a 12-ohm receiver.

Several types of these Detecta-Phones have been developed in the past years, but that invented by Gaillard Smith is one of the most sensitive as yet produced. His instruments are most employed by detective agencies, and, of course, a large number of them are used by deaf people. Our Fig. 1 (lower right) illustrates a Detecta-Phone used by the deaf. The transmitter is depicted on the right, while the receiver is shown toward the left. One of the features of the transmitter is a variable resistance for producing different intensities of sound in the receiver. Consequently, with this instrument one may vary the sound according to the needs of the user. The instrument is enclosed in a compact leather case, as shown, and can be carried around very readily in the pocket.

As was stated previously, the Detecta-Phone is used extensively by detective agencies. Fig. 2 (top right) portrays William J. Burns, the famous detective, using one of Mr. Smith's instruments. The transmitter is held in his left hand, while the index finger of his right points toward it. Note that double headset 'phones are used by detectives in order to get the full value of sounds produced in the transmitter. Practically every investigation made by the present detectives is entirely done by the use of these supersensitive telephonic instruments.

This inventor has also turned his mind to the development of these instruments for office work. Fig. 3 (top left) illustrates this application. Mr. Smith himself is seen using his Voca-Phone, which merely consists of a transmitter T of the type that has been previously described and two loud-speaking telephone receivers R R enclosed in a wooden case with suitable horns provided on each receiver, as is clearly shown in our photograph. One of the most important features of this Voca-Phone lies in the method of calling a certain party on the line. This is done by moving the transmitter signal arm toward the point on the scale corresponding to the party wanted. A small indicator is connected to this transmitter arm and travels across a small scale showing where this particular point is located. This scale is shown at the bottom of the Voca-Phone. A small push-button is provided on top of the instrument and it is used for calling purposes. In using this instrument one need not stand near the transmitter as in the present mode of telephoning, but the user may sit comfortably back in his chair and simply talk in a moderate tone. His voice is very readily transmitted to the receiving party.

Top Left: Mr. Gaillard Smith, Inventor of Detecta-Phone, Using His Loud Talking Desk Telephone. Top Right: Detective Wm. J. Burns Uses the Detecta-phone. Insert View Shows Parts of New Tuned Microphone. Lower Left: Craig Kennedy, of Movie Fame, Employs the Smith Voca-Phone. Lower Right: New Supersensitive 'Phone for the Deaf.

The Voca-Phone has been utilized recently in "The Exploits of Elaine" film. Fig. 4 (lower left) shows "Craig Kennedy," the detective, receiving some startling information with it.

One of the latest achievements in this line is a new "transmitter" whereby the musical "keys" can be exactly reproduced, and Fig. 5 (top right) shows this transmitter dissected. The upper central portion of the picture shows the make-up of the interior of the transmitter. A is the transmitter shell, made of a very light composition metal, and B the carbon cup. This cup is made of a special grade carbon, chemically treated, and contains six small holes as perceived. These cavities contain a large number of highly polished carbon balls, which are imported from France. These balls are hollow, making them exceedingly light for their size. The most important feature of this transmitter is the very small resistance coil C. A small contact arm D is used to vary the resistance on this coil. In order to produce a particular musical "key" the small handle D is moved to a certain point on the scale which is provided in the shell. The cap of this transmitter is shown on the right of the photograph, while toward the left the receiver is shown. When the diaphragm and cap are threaded upon the transmitter and properly adjusted it is a complete unit of itself, and can be carried around quite easily without distorting the interior parts.

When Bell Introduced the Telephone

1916 Is the 40th Anniversary of the Telephone

The telephone has become such a matter-of-fact apparatus that to-day none of us hardly ever stop to realize that it is possible that less than 40 years ago the telephone was purely a laboratory device of few and doubtful virtues. Men there were, and highly educated ones at that, who scoffed at Alexander Graham Bell's "musical ear," as it was at one time called, but so it has been in all ages with new discoveries.

Early Demonstration of the Telephone by Bell.

Bell, however, was a persistent and indefatigable worker and, unlike some inventors who have not lived to see the "child of their brain" developed and perfected to the wonderful degree attained by the telephone, he and his early assistant, Mr. Watson, have lived to see the telephone on practically every man's desk and on the wall of nearly every dwelling in this country and abroad.

The interesting illustration here reproduced is from an old wood cut and shows Prof. Bell trying out his somewhat heroic size telephone of early vintage in a lecture hall at Boston prior to a lecture and demonstration of the speaking telephone. Even the man with the brush is apparently somewhat startled, as well he might have been, for the telephone in those days was considered by most people as either a pure fake or as an incredible scientific monstrosity, but Bell knew better. In most of his early demonstrations and lectures it was usual to run a short copper wire line or circuit to Bell's laboratory, the illustration showing such an arrangement. In this case Mr. Watson did the talking at the labratory and the speech was reproduced by one of Bell's "speaking ears," which part of the human anatomy it very much resembled in those days, to be sure.

It must be realized that the apparatus with which this early inventor was struggling was a very crude and much misunderstood quantity. Nothing definite was known about the proper diaphragm to use, nor its size, nor was there anything definite known about the proper strength of the magnets to use, nor with what size wire they should be wound. Even though the proper size wire had been known, it is doubtful if it could have been procured, as magnet wire in those days was very scarce and usually had to be made to order at great expense.

Mr. Watson, who recently lectured before the New York Telephone Society on some of his early telephone lecture experiences in conjunction with Prof. Bell, related some amusing circumstances surrounding the public demonstrations in which the telephone did everything but talk. In some cases, needless to say, it took but very little to thoroughly provoke and send home an audience who were expecting to hear a *loud and perfect telephone*, "right off the bat," so to speak.

However, Bell's little instrument lived up to its promise in most instances and proved beyond the shadow of a doubt that the inventor could really reproduce the human voice by electrical and mechanical means. Mr. Watson mentioned one occurrence which had New Brunswick, N. J., for its locale. On this particular glorious occasion there was to be no less a personage than a grand opera soloist from New York City, who was to sing into the transmitter of the telephone at some distance from the lecture hall and the audience was thus to have a musical as well as a scientific treat, it was promised. But, like a great many other such things on which we calculate to the final dot, things did not go right, for the reason that the opera singer's voice was not quite suited to the telephone, of that day at least, so Brother Watson had to fill up the rest of the evening with suitable selections from his not too extended repertoire, and the audience went home well pleased, and none the wiser.

THE MYSTERY.

By G. LaPalma.

I AM the Swift—I am the Beautiful—I am the Terrible—I envelop the world with My Strength, and men thank God that I am, yet tremble in fear of My Approach.

I am old—so old the mind of man cannot conceive numbers sufficient to count the years of My Being, but still I am the Personification of Youth and Power.

For ages and ages I have played through the Heavens, and deep in the Bowels of the Earth I have wrought Mysteries yet unknown to man. I have lit up the skies with My Presence, and at the deep roaring boom of the thunder I have wrapped whole Forests in Sheets of Fire, smitten rocks to fragments, and sent, in panic, the wild beasts rushing through the jungle. I have played 'round the spindling towers man built, leaped o'er mountains, moved the wild sea, and found My rest in the bodies of people who know not My Presence.

Now man has found Me—A willing servant, I fetch and carry, lighting man's home and the streets, speeding his words on currents of air to far-distant countries, turning the wheels of thousands of mills, driving his cars in the city and doing his toil in the country. Oh! Countless are the things I give in Light, in Heat, in Power, yet even the ones who know Me best know nothing about Me. And though their hands are bold, their hearts are timid.

I am the World's Mystery. I am the Terrible, the Beautiful, the Omnipotent.

I am ELECTRICITY!

ALESSANDRO VOLTA.

Alessandro Volta, the inventor of the electric battery, was born in Como, Italy, Feb. 18, 1745, in a house where the Volta family had lived for more than 300 years. When a child, strange as it may seem, he was very backward. He was four years old before he spoke even his first word "No." From the time of this event, however, his mind seemed to turn entirely to the wonders of nature.. At 17 he won prizes in philosophy. When he was 18, the famous Abbe Nolet, impressed with the boy's great knowledge, had him write essays on electricity for the great men of the day, for people in general knew very little about this mysterious force at that time.

His first formal papers were issued in his 24th year. Fourteen years later appeared the Volta *electrophorus*, followed by his *electroscope*. Shortly afterwards Volta was made professor of physics at Como, and the year succeeding accepted what became a 40 years' professorship at Pavia. Experiments here led to the discovery of the *Voltaic pile* or battery, the first device ever made for producing continuous electric currents.

Famous throughout Europe, Volta received many honors, being created a Senator and a member of the French Institute. He remained personally, however, exceedingly unpretentious and was much beloved by the Italian peasants, who called him. "Il mago benefico," meaning beneficent magician. He died in 1826, but his name will live as long as electricity stands as our motive power, because the unit of electrical pressure has been designated as the Volt.

Alessandro Volta, After Whom the Volt Is Named.

The Electric Gyro-Cruiser

A Rolling Electric Gyroscope Fort of the Near Future. By Eric R. Lyon, A. B.

THE world will have wars for generations yet to come, but the time is near at hand when their destruction of human life must cease. How is this to be? Simply that all future war must be naval warfare, by which we mean there must be a navy for each of the three elements, earth, air and sea. We have our navy on the sea, and we have begun our navy of the air. Who knows but that our last and greatest navy stands now upon the threshold of human ideas, awaiting only a proper invitation for its entrance into our affairs?

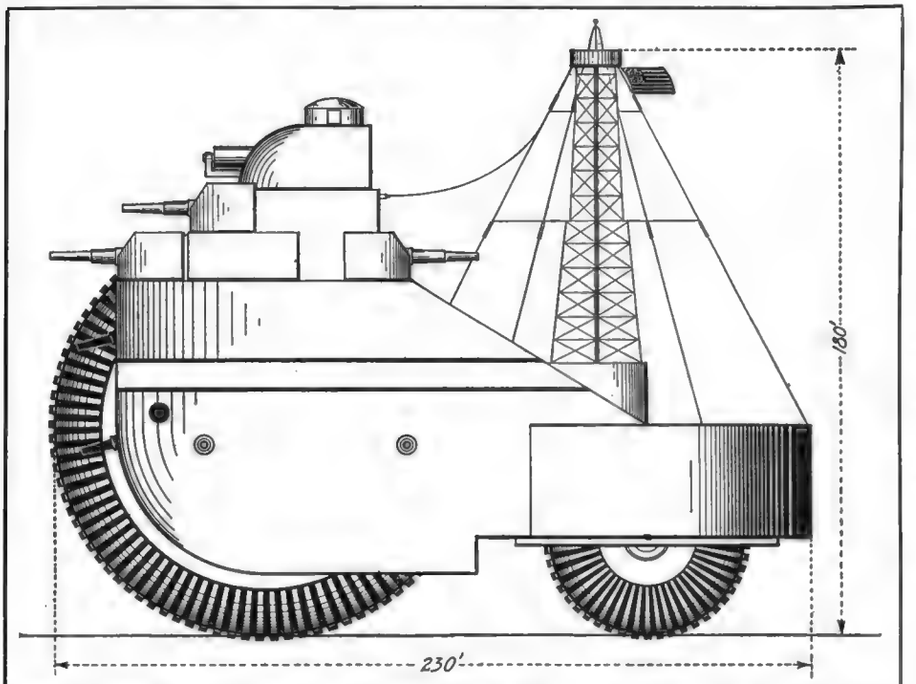


Fig. 1. Side View of Possible Land Cruiser of the Near Future. It Could Smash Any Fort With Its 42-Cm. Guns.

Suppose Great Britain's giant navy could now come up out of the sea into the plains of northern France and, mounting itself upon wheels, dash in single line formation at express train speed upon one single, unsuspecting and strategic point of Germany's hundreds of miles of battle front. What would happen?

We are told that "this is a war of ammunition;" that the decision of this war is practically a question as to which side can ultimately hurl the most tons of shot and shell into the trenches of his opponents. Now we know that if you and I and Smith and Jones and all of our neighbors are strung out over a hundred miles of battle front it is going to take an enormous amount of shelling to shell us out. But if the enemy should suddenly concentrate all of his fire upon Jones' pasture, or even upon 15 miles of battle front adjoining the pasture, there is not going to be one man left alive in all of that harnel ground to prevent the enemy breaking through. This, in brief, is the tactics of the present war. The enemy does break through. His infantry runs, his cavalry gallops and his big guns creep; all trying to get through the gap in our lines. In the meantime the warning has gone out broadcast to all of us. We rush in our reserves, and move up our own big guns to defend the breach. We storm the field. We mow down his necessarily massed ranks as with a reaping machine. We convert that 15 mile breach into a veritable inferno of hail, wind and destruction; or steel, fire and blood. The enemy is forced to retire; that is, all of him left to retire. We close up the breach, dig in again and await the next assault. This also is the tactics of the present war. Our infantry can move as rapidly as the enemy's infantry; our cavalry can gallop as hard as his cavalry, and our big guns can creep as slowly as his big guns. Consequently we were there in force before he could break through far enough to do him good. The net result of the whole encounter is another blood sacrifice to the war demon, and another call for ammunition on both sides.

Transferring ourselves from Jones' pasture to a point overlooking that select portion of the German battle front which we before mentioned, we may now imagine what begins to happen as the great British fleet comes in range behind the distant horizon. Our first warning of the impending battle is the increasing rattle of machine guns in the clouds, as the few local scouts of the German aerial fleet flee before the concentrated and overwhelming British aerial navy. Presently down comes a German Taube in flames. The British planes are circling far overhead and are signaling the ranges to the British gunners behind the horizon. The staccato roar of the German anti-aircraft guns has begun There is a distant rumble. The one remaining door of the hut in which we have taken refuge shudders, and immediately 10 or 20 bursts of flame search out the German batteries. In range of this 15 or 20 mile strip the Germans have 11 big howitzers. These are the chief concern of the British gunners. The British aerial fleet signals back the results. In the meantime one Taube scout has succeeded in landing behind the German lines. Ranges and movement of the British land fleet are immediately 'phoned to the German gunners. The big howitzers open fire, but the British aerial fleet, pursuing the Taube scout, had signaled warning to their land fleet when they could not prevent the scout's landing; and so, when the German 42-centimeter shells tear up a certain plot of ground behind the horizon it is from another point behind that ominous line that the first great answering salvo thunders forth. Through the glass we observe a distant German battery go up in flame and twisted steel. The thunderings become incessant and they seem to be coming nearer. Their salvos must be finding the targets. Suddenly the field has become alive with the bursts of six-inch shells seeking out the Germans' lesser batteries. Panic reigns. Through our glass we can see men and cannons dashing madly to new positions away from the bursts of those deadly pursuing shells. Yet not a man can we see going to the rear. The Germans have even in their despair resolved to stand their ground and die before the overwhelming onslaught. But neither do the British shells fall among the massed German infantry reserves, nor in the trenches armed only with machine guns and men helpless in the vortex of

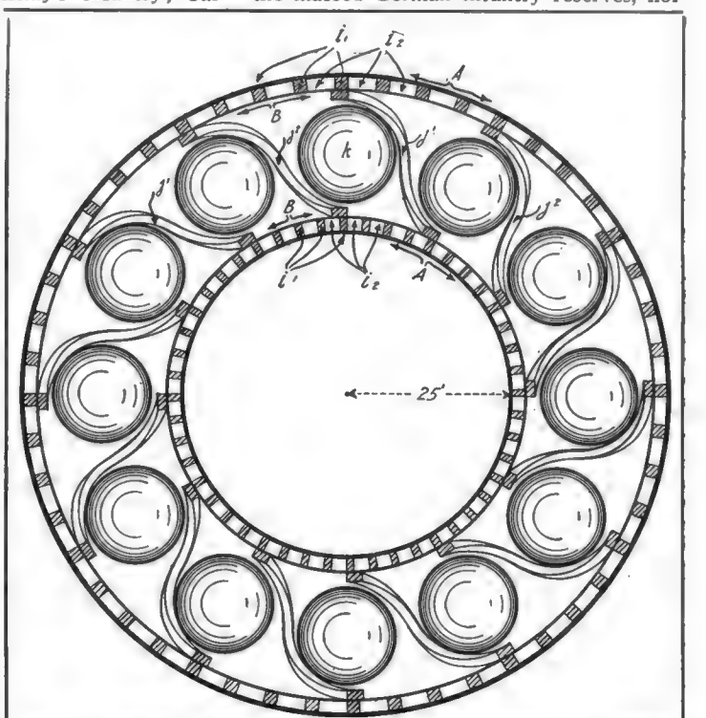


Fig. 3. Sectional View of Massive 2,000-Ton Liquid Gyroscope for Maintaining Equilibrium of Land Cruiser.

this maelstrom, for Britain has not elected to slaughter her enemies, but to overcome and to disarm them.

At last the hail of shell has ceased in the district under our observation and has swept out like a scythe into the far outlying districts. The breach has been made. The British monsters appear upon the horizon thundering, flaming, racing; bearing down upon us at express train speed. Onward they come. Presently one sweeps past into the gap and then another and another.

The memorable raid of the British land fleet had begun. It is recorded—and so it will be when the imagined incident here pictured shall have become a matter of past history—it is recorded that the British land fleet, having broken through the German lines, cut a swath of destruction through to Berlin more effective than even the famous Sherman's march through Georgia, and as they rode they destroyed every means of communication, of transportation; every munitions depot and provision depot; and ending with the destruction of the great Krupp works, there followed the surrender within a few weeks of the whole German army for lack of provisions and munitions. A new epoch was begun.

This is the picture of the possibilities of the new arm of military power. Now let us consider the probable form of its machinery. The form which first suggests itself is, most naturally, an overgrown reproduction of the common four-wheeled truck or wagon, and if such a device were designed to operate only over level ground or over especially prepared roads of about 100 feet in breadth it would be capable of good service and great speed. It would be possible to construct such roads all along the coastal country to be defended, and yet the four-wheeled units would be sadly hampered by their inability to operate away from the ideal conditions so prepared. If a unit of the future land navy, or a land cruiser we may call it, is to be of real service it must be able to maneuver anywhere over any kind of ground except precipices, and it must be able to make express train speed over common country roads and over the fields of gently rolling country. A device of this type is possible only when it shall employ some other means than a broad wheel base to maintain itself upright. Indeed, if the land cruiser is to be operated over country roads the breadth of its wheel base cannot exceed the breadth of the road, some 25 or 50 feet, which fact would necessitate balancing the structure upon not more than two great wheels—bicycle fashion. Going at full speed our huge device would be able to balance itself after the manner of a bicyclist, but it must also be able to maintain itself firm and upright even when standing still. To accomplish this there is one practical means of which we are aware, and that is the gyroscope.

Let us then call our land cruiser a gyro-cruiser. A likeness of what this may be we have in Fig. 1. Gyro-cruisers will begin, of course, very humbly, and at first will be gyro-trucks rather than gyro-cruisers. The conditions of mounting the gyroscope in the gyro-truck; the conditions of mounting the weight of the structure upon its wheels and, in fact, almost all of the conditions governing the small device will be different from those which will be found for the huge machine. So it is not with the steps upon the way, but with the type of the full-grown cruiser, of the gyro-navy in its prime, with which we are now concerned. Such, we may imagine, is the American gyro-cruiser shown in Fig. 1, with its extreme height of 180 feet from ground to top of fire control mast, its extreme length of 230 feet, its maximum breadth or beam of 87 feet and its maximum wheel breadth of 25 feet. The weight will be about 20,000 tons, one-tenth of which, 2,000 tons, will be the weight of the liquid gyroscope carried in the rim of the great wheel. The latter may be seen projecting downward and forward of the main substructure in the diagram, Fig. 1. The gyro-cruiser will mount 12 17-inch guns (or will they by that time have grown to 27 inches?) in six turrets, three of which are shown, the other three being similarly placed on the other side of the superstructure, and will be able to fire a salvo of eight guns in nearly every direction from the cruiser. Instead of the customary arrangement of low caliber guns, as in a battleship, an arrangement which is made necessary by the manner of firing with respect to the roll of the ship, the gyro-cruiser will mount in the 40-foot crown turret shown a huge machine gun, comprised of a rotating cylinder having mounted in it a sufficient number of complete and individually recoiling six-inch rifles, which shall be electrically fired as they successively pass through a predetermined firing position. One man will be able to aim and control the fire of a torrent of six-inch shells, and thus a weapon will be provided which, being peculiarly adapted to the gyro-cruiser, will give the latter added superiority to any other type of military unit operating upon the land. The great wheel shown in Fig. 1 is the traction wheel, and it is 108 feet in diameter from one beveled, cutting-edge foot to the other. The "little" wheel, which is 60 feet in diameter, is the steering wheel, and is also the balancing wheel—a fact which is apparent when we consider that in order for a gyroscope rotating in a vertical plane to exert its balancing power about a horizontal axis, it must be able to swing freely about a vertical axis. The uses of the aerial and fire control mast are obvious.

Passing to Fig. 2 we have a detail, vertical cross section cutting the cruiser in a plane passing up through the center of the great wheel. We will follow the latter in explaining this diagram. On top is the crown bridge. It is heavily armored, rotates like a turret and carries the armored range finding arms, the eyes of which are now staring at the reader. Other range finding stations will be located at the top of the first control mast and at various points about the cruiser. It shall be the duty of these stations, not only to obtain the ranges of the enemy's positions, but to maintain an accurate running survey, analogous to the log at sea, from which the exact position and orientation of the cruiser may be told at any time. The complete control of the cruiser will be centered in the crown bridge, but there will be duplicate control stations in the main bridge (a) and at other points. The officer on watch at the crown bridge's range finder will have complete control of the cruiser, and he will electrically train and fire all of the guns, at the same time following the results of his own operations through the huge telescopic range finder.

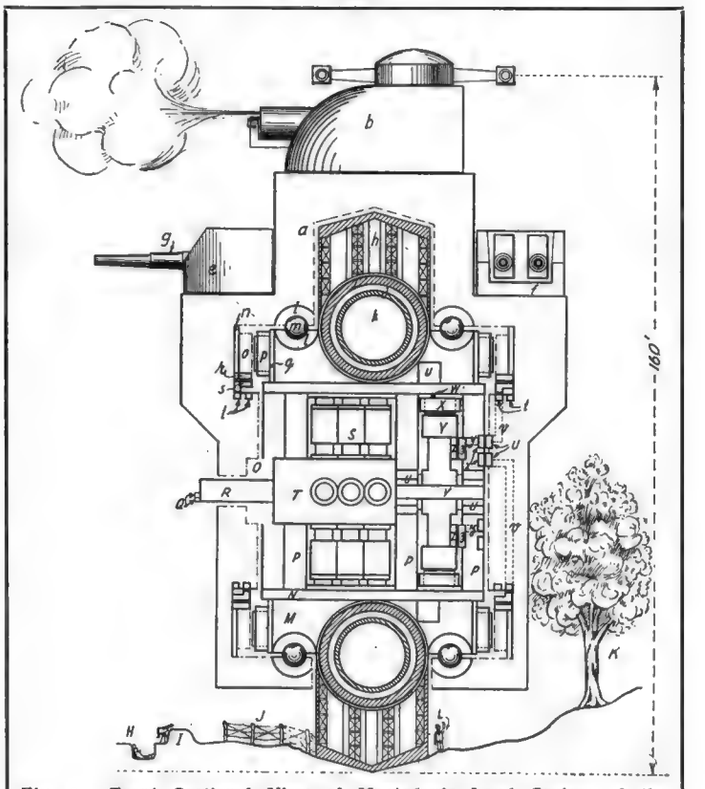


Fig. 2. Front Sectional View of Mastodonic Land Cruiser of the Future. Note Comparative Size of Man Here Shown.

(b) is the crown turret carrying the six-inch rifle machine gun described; (a) is the main bridge, offices, range plotting rooms, etc. Forward of this, but not shown in any of the diagrams, is the main searchlight station; (e) is a 17-inch gun turret, side view; (f) is the same, but looking into the business end of the guns; (g) is a 17-inch gun; (h) is the bevel-fa d and very heavily armored foot or rim of the great wheel.

All inside of the broken line .—.—.—. is part of the great wheel and rotates with it. The armor of (h) is put on in plates parallel to the plane of the wheel, which is to say, perpendicular to the plane of the section. The plates will be welded together, making the rim of the great wheel one solid mass of steel capable of supporting the weight which it must bear and capable of withstanding the enormous centrifugal or bursting effort of the liquid gyroscope—the latter is carried immediately below (h) in (i), (j) and (k).

(i) is a cross section of the lining of alternate magnet coils and iron rings in the tube of the liquid gyroscope; (j) is the space in which is wound the spiral of *non-magnetic* steel which causes the liquid to spiral round the tube in a second rotation impressed upon the primary one; (k) is the hollow propelling ball of iron and steel faced construction, 15 feet in diameter, which floats in the liquid and which is sucked around and around the tube by a rotating magnetic field, just as is the action upon the shell in the proposed electro-magnetic gun: (1) is the section of a ring of heavy welded armor which, like the ar-

(*Continued on page* 587.)

New Telephonic Novelties

LOUD SPEAKING TELEPHONE A BOON TO SALESMEN.

With this new adaptation of the loud speaking telephone, show window demonstrative advertising becomes a really convincing argument. It is no longer necessary to ask the audience to stand out in front of the window and read placards; instead, the demonstrator telephones his information right into the crowd, and he can tell them in the most business pulling arguments just why they should buy his wares.

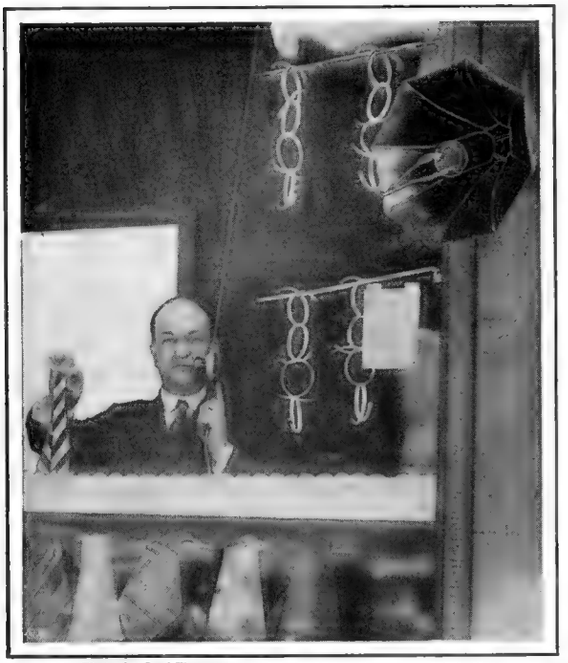


Photo by Paul Thompson.

This Salesman Talks to His Public Through a Loud-Speaking Telephone Fastened Outside the Show Window.

This new telephone apparatus for show window demonstrator's use was perfected into this highly practical instrument by B. H. Hogan, who, being a salesman, realized how important it is in selling goods to talk personally to the prospective customers.

The apparatus is a simple affair which can be detached in a few minutes and packed in a medium size traveling bag. It consists of a transmitter, into which the demonstrator speaks, just like into an ordinary telephone, but at the other end of the line is a horn, similar to that on a phonograph. In this horn, which is clamped to the building, just outside of the demonstrator's show window, is a strong electromagnetic reproducer which takes up the sound waves and throws them up against a sound board in the rear end of the horn. They are deflected back and out of the horn into the listening crowd. So strong is the voice reproduced that it can be plainly heard amid the surrounding street noises for a distance of 25 feet from the window. Sometimes two horns are employed, located 10 to 30 feet apart, to accommodate a large crowd, so that all may hear clearly every word the demonstrator says.

This new telephone derives its electrical current either from an electric light socket of 110 volts, or, in case no current is at hand, from batteries producing 18 volts. It will work either on direct or alternating currents; but, in case of the latter, the voice is harsh but by no means so indistinct that every word cannot be understood.

The apparatus pictured is being used by the inventor, it being the first one to be put to practical use in this line. The novelty of the situation never fails to draw a large crowd.

LATEST ELECTRICAL AID TO THE DETECTIVE.

One of the greatest obstacles encountered in the present dictagraphs, as used by detectives, is that of the unnecessary noises produced by the super-sensitive transmitter due to vibration, etc. Although various devices have been developed for the purpose of eliminating these sounds or side-tones, none of them has proved much of a success, but the one invented by Gaston Boissonnault, a prominent worker in this field, has shown far more superiority in its acoustic qualities than any one of the dictagraph type of instruments heretofore produced.

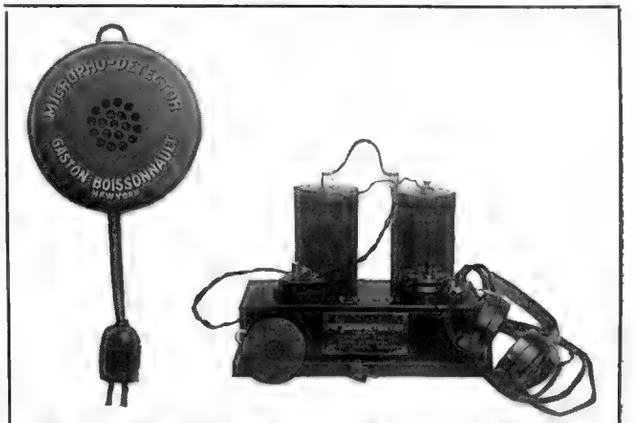
His transmitter or "sound collector," as the inventor calls it, is clearly shown in Fig. 1. This is constructed in the same way as in the standard type, but the various parts are more finely built and the carbon balls and carbon diaphragm are very highly polished. The outside side-tone noises are eliminated by the proper adjustment of the transmitter.

The receivers are a very important factor in this instrument; they are of the low resistance type, some of them varying in resistance, depending upon the condition under which the instrument is used; that is, some instruments require a low resistance 'phone because of the acoustic qualities of the room where the transmitter is placed; if it is a large room, a very low ohmage 'phone will be required.

The inventor, Gaston Boissonnault, has succeeded in improving his apparatus to such a degree of perfection that he has developed an instrument for detective work, and many of these are at present employed for that purpose. One of these detective type instruments is illustrated in Fig. 2. One of the clever features embodied in this outfit is the "fake" desk telephone seen at the right of the case. This looks exactly the same as the standard desk style instrument, but instead of having a regular transmitter a sensitive microphone of the type above described is placed in the microphone shell. The receiver is a "dummy" and it is not connected to any part of the telephone. Only two wires are brought down from the transmitter. This "phoney" instrument excites no suspicion whatever, as it appears to be connected with the usual Central Exchange and is naturally out of use as the receiver is on the hook, apparently. The listener can, however, hear through the instrument whether the receiver is on or off the hook. Three sets of receivers are used with the apparatus; one being seen on either side of the case and one in the center of the cover in the picture. The instrument is installed with a sound regulating switch. Two reels, carrying flexible cord, are shown standing against either end of the cover. The batteries are enclosed in the case, thereby making the complete outfit thoroughly portable and ready for instant service.

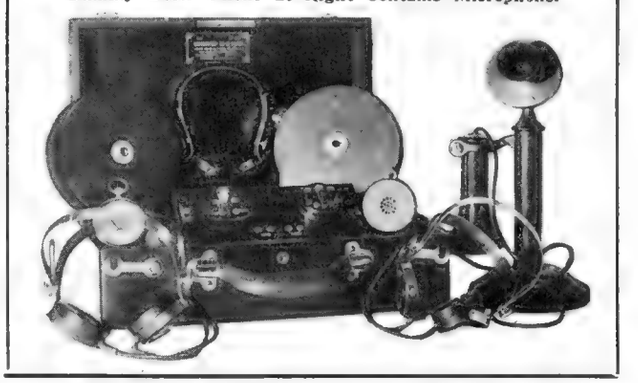
Another instrument of similar character is depicted in Fig. 3. This is of a smaller size and intended to be used in factories where several of these transmitters are located in different departments, while the receiver is placed either in the president's or manager's office, and in this way the "boss" is always secretly informed as to the condition of affairs in any particular department. He is also informed, secretly of course, as to whether his employes are talking for or against him, and thereby he can prevent strikes, providing the employes are plotting same, and in this way he is constantly informed about the inside conditions in his entire plant.

Several of these instruments have been advantageously used by several of the warring countries in detecting spies; plots were thus frustrated that were being talked over in the buildings and mansions around the battlefield.



At the Left (Fig. 1): New Dictagraph Microphone; at the Right (Fig. 3): Small Model of Dictagraph Set for Detective's Use.

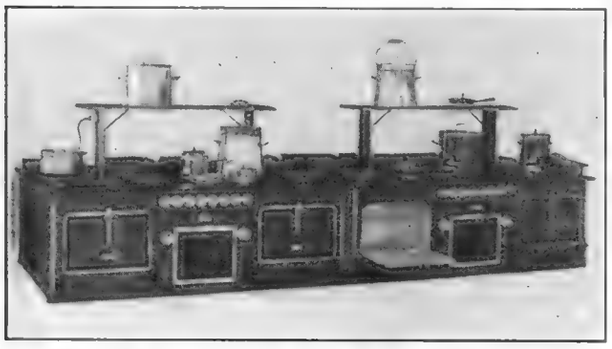
Below (Fig. 2): Complete Dictagraph Outfit for Detective's Use. Dummy Desk 'Phone at Right Contains Microphone.



Only 3.2 per cent. of fires requiring the attention of New York's fire department during 1914 were charged to electric origin.

Monster Electric Range to Cook for 1,500 People

Following a recent investigation of the practicability of electric cooking, the Montana State Hospital for the Insane, at Warren Springs, Mont., has purchased one of the largest electric ranges in the world for immediate installation in connection with an unusually efficient system of food handling and serving between the hospital kitchen and the dining rooms. The range is the largest ever built and has a total connected load of 69 kw. It is built in four similar sections, each 7½ ft. long and 2 ft. 9 in. wide, and is to be installed with sections back to back, occupying a floor space 5½ by 15 ft., enabling the cooking staff to work on both sides.



Giant Electric Range to Cook for 1,500 People at Montana State Hospital.

In general design the range is similar to one installed by the same manufacturers at the Southern Indiana Hospital for the Insane, which provides for 1,000 persons, but the Montana range has eight ovens instead of six and a proportionate increase in the top equipment. There are two ovens in each of the four sections, each oven having sufficient capacity to roast 24 chickens or 80 pounds of beef at once. Each section is a complete unit in itself, permitting their arrangement in any desired order. If the sections were placed in a single row the range would be 30 ft. in length. The range is of steel throughout, with polished trimmings, and is superior in workmanship and durability to coal and gas ranges. The top equipment comprises the following units, each controlled by a separate switch with ruby pilot light and three adjustable heats. Seven 10-in. by 24-in. hotel griddles with rims, two 18-in. by 24-in. flat griddles or hot plates, one 12-in. by 18-in. corrugated surface broiler, one 12-in. frying kettle for deep fat, one 6-slice hotel type bread toaster, five 15-in., two 10-in. and five 8-in. hot plates.

The heating units are of the enamel type and the controlling switches are conveniently mounted on the front of the range at a height providing for minimum labor in handling. The estimated maximum demand is 46 kw., and on the basis of 0.25 kw.-hour per day per person the energy consumption will be 259 kw.-hours per day, or 7,500 per month, making the cost of electricity, on a 2-cent rate, $150 per month. This is offset against the cost of coal, cost of handling coal and ashes and additional attendance required for handling a coal outfit. There will also be decided savings in food due to superior cooking as compared with coal or gas ranges, avoiding waste due to over and under cooking, excessive shrinkage, etc., which in many installations amounts to more than the cost of fuel.

UNIQUE CALL SYSTEM FOR BUILDINGS.

In an office building of 22 stories that is kept in good condition, there is a staff of mechanics constantly in service. To find the foreman of any of these gangs is a problem, since he may be in any of a dozen or so rooms. In the superintendent's office is a little switchboard with three flush switches each controlling a lamp on the board for a pilot and one of three over the freight elevator door on every floor, says B. R. Browne, in *Electrical Review and Western Electrician*. Red, white and green lamps are used. Each foreman has his call; for instance, the electrician's is green, the carpenter's red and white, the head porter's white, and so on. When the superintendent wishes to speak to any of the staff he calls by this lamp signal and the party called plugs a pocket telephone set that he carries into a little flush receptacle beside the elevator door on any floor and he is then in communication with the chief.

The whole thing is so simple and flexible that it could readily be adapted to suit any requirement of factory or office building.

By being placed near the freight elevator it is easy to wire, using conduit and condulet fittings. All that is exposed comprises three condulet receptacles over the door, the conduit running up the shaft and a short extension coming through the wall on each floor.

The pilot board is placed beside the telephone private branch exchange in the office of the building, so that the operator cuts off the signal when the conversation is closed. The lights are conspicuous enough for some of the staff to surely see, and yet are not as objectionable as a bell or other call in a public building. All stock materials can be used.

THE POTENTIOSTAT FOR HOSPITAL CALLING PURPOSES.

From time to time many clever and unique devices have appeared for use in hospitals, particularly for calling the nurse or the doctor, as the case may be. This new device, however, combines all the good points of all these ideas and has not a few original features.

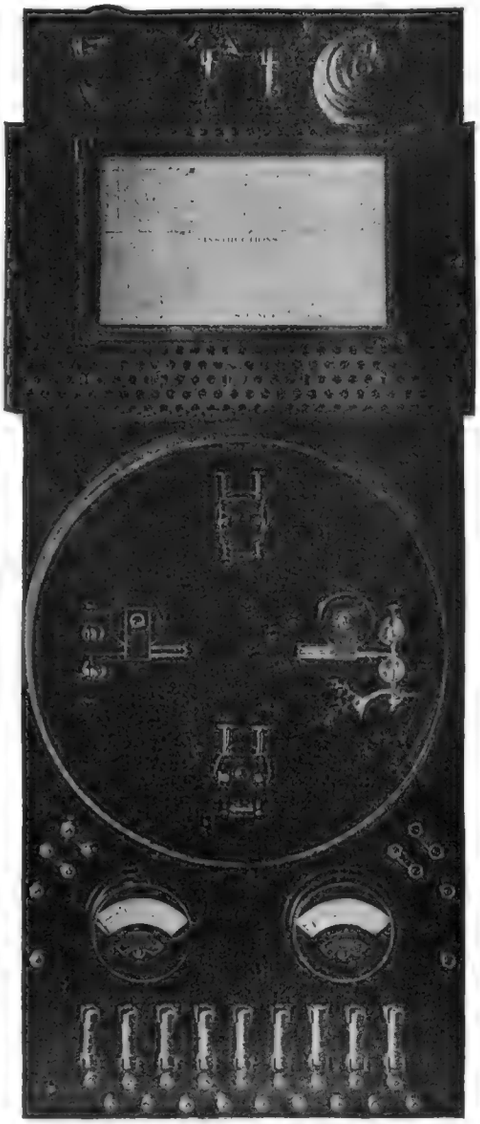
Primarily it consists of an automatic storage battery charging board and a push button of novel design, placed at the side of the bed. The apparatus is mounted in front of the nurse's or doctor's desk and miniature incandescent electric bulbs are placed on the board and operate in connection with the annunciator.

The complete system in outline works as follows: Whenever the patient desires the services of the nurse he merely presses the push button, which lights a certain lamp on the board and the annunciator indicates at once which patient is calling. The lamp remains lighted until the nurse answers the call. After attending to the patient she merely pushes another button placed near the bed, which extinguishes the light.

Practically all of the previous signal systems were operated on low voltage current, but the method of reducing same from 110 volts to the required voltage being very inefficient, made the operation of these systems on a large scale very expensive. This decided weakness and consequent expense was brought to the attention of several engineers and many devices were developed, but with very little success until an instrument was perfected for reducing high voltage to a lower voltage economically.

This is called the Potentiostat by its manufacturers and is herewith shown. In detail it consists of a number of storage batteries which supply the current to the lamps or bulbs. The batteries are charged automatically from time to time from the regular street mains. The charge is controlled by an automatic circuit breaker observed in the center of the Potentiostat. A volt-meter and ammeter are provided for determining the exact condition of the cells.

The system here described has power enough to handle 365,000 bells or lamps, which is a good deal more than it will ever be called upon to operate most probably.



The Potentiostat Can Ring 365,000 Call Bells or Signal Lamps, the Latter Being Used for Hospital Service.

The advantages of this new system are apparent when it is considered that the light will continue to burn as long as the call is not answered, and any delinquency on the part of the attendant will be readily noticeable by the undue length of time which the lamp operates. This device has proven its value repeatedly at various hospitals where it has been installed by increasing the quality of the service.

New Arc Lamp Consumes No Electrodes

This New Arc Lamp Marks the Greatest Advance in Illuminants in a Decade

SINCE the advent of the gas-filled incandescent lamp bulb, science has led us to believe that the only step remaining to make an ideal illuminating unit would be the invention of cold light. However,

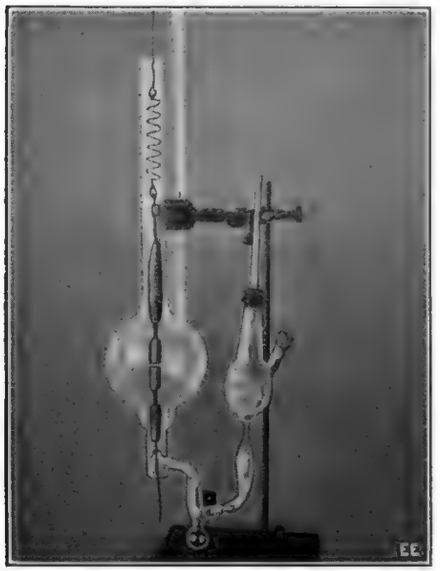


Fig. 1. Appearance of New Arc Lamp That Does Not Consume Electrodes.

there has appeared a new and novel arc light which burns in a gas-filled chamber. It may be remarked that the arc lamp was the first electric lamp of any practical importance.

This new lamp, the invention of W. A. Darrah, is the outcome of a series of elaborate and painstaking experiments on various forms of electrodes and different mixtures of gases in the chamber. In its present form it consists of two tungsten electrodes which are not consumed, and the arc burns in an atmosphere of certain gases. The lamp is shown in Fig. 1, and, as will be seen, comprises a glass bulb containing a predetermined amount of gas (a mixture of titanium tetrachloride and bromine gas), and having supported from the opposite ends the two tungsten electrodes.

The working parts of this lamp are indicated in Fig. 2, and the general idea of its operation can be obtained therefrom. The large glass bulb is approximately the size of an ordinary incandescent lamp and has mounted at the lower end a solid rod of tungsten ¼ inch in diameter. The connection to this rod is made through a small tungsten wire. The upper neck of the tube supports a sliding iron core in which is mounted the other tungsten electrode. A flexible conductor connects the upper electrode with the seal in the globe, and a coil of wire around the iron core (see diagram) of the upper electrode serves to start the arc and regulate same. This regulation is very easily accomplished, due to the fact that the electrodes are not consumed, and, being automatic, the lamp may be operated from an ordinary switch.

The effect of gases on the stability of an arc was determined by Poulsen in connection with his experiments with arcs for wireless telephony and undamped wave radio transmission. The same effect is here obtained by the gases used inside of the globe. They render the arc intensely luminous and very steady. The gases themselves are consumed at a very slow rate, and thus the globe is not blackened. The lamp requires no more attention than an ordinary incandescent bulb.

In operation this lamp gives an arc from 2 to 5 inches long, depending, of course, upon the voltage, and the arc proper is about ⅛ inch in diameter. It has the appearance of a bright, white incandescent filament. It does not flicker like an ordinary carbon arc in the air, and the intense light has a spectrum almost identical to that of the north sky on the afternoon of a clear day. In other words, this means that the lamp gives a light not unlike daylight, the only difference in the spectrum being due to the slight absorption of the

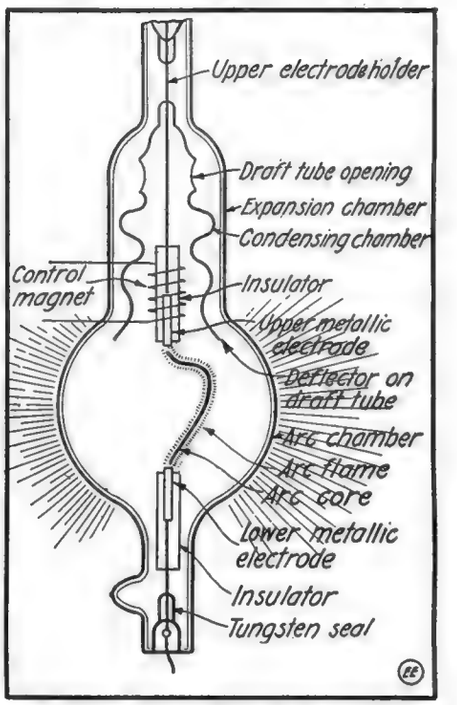


Fig. 2. Diagrammatic View of New Gas-Filled Arc Lamp, Which Seems to Possess Great Promise.

various spectrum lines by the vapor in the lamp.

Although this arc lamp is still in more or less of an experimental stage, it gives considerable promise of supplanting the modern incandescent light and becoming a large factor in the illumination of the near future.

ELECTRIC MOTOR BUCKETS, THE LATEST.

Electric motors have been adapted to many diversified requirements in the industrial line, and it seems as though these

Fig. 1. Small Grab Bucket Opened and Closed by Electric Motor Mounted Directly on Same.

adaptations had come almost to an end, but every day there is found some new and worth-while application of the electric motor, which has so far remained unsurpassed for high operating efficiency, cleanliness and ease of control.

One of the latest uses of the electric motor is its incorporation in the design of large grab-buckets, as the illustrations herewith portray. Fig. 1 shows a large clam shell bucket suitable for scooping up coal, dirt, or other loose material, and the operator is seen plugging in the flexible cable leading down from the crane into the motor terminal block. As perceived, the motor operates the bucket jaws through the medium of a short, but powerful chain belt. The many advantages of this arrangement are self-evident, as any extended length of control cables or ropes which have caused immeasurable annoyances in the past are done away with. The motor in this case can be operated by the man in charge of the crane or derrick, to which the grab-bucket is attached or where the bucket is used in shops and manufacturing plants on a traveling rail, a short switch chain extending from the motor enables anyone to operate same with ease and dispatch.

Fig. 2 shows a powerful electric motor bucket equipped with steel teeth and intended for digging in hard materials, such as dirt mixed with rocks, etc. These newly devised buckets are supplied in a large variety of designs and special types are furnished whenever necessary. The flexible electric cable supplying the motor current, it may be mentioned, is wound up on a spring-propelled drum attached to the crane or derrick.

The many advantages accruing from this distinct and valuable advance in engineering design is at once apparent to anyone who has ever watched a grab-bucket at work. No end of trouble is encountered

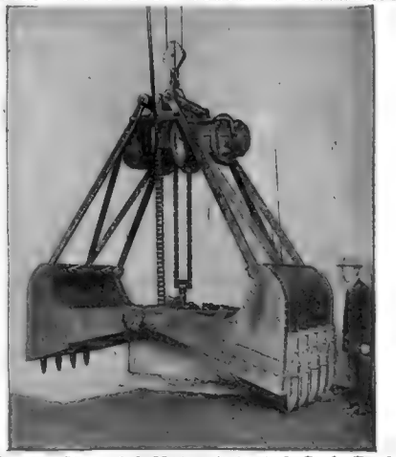


Fig. 2. Powerful Motor-Actuated Grab Bucket Fitted with Teeth.

regularly in the operation of cable-controlled buckets of this type. Again, they often fail to close fully, but not so with the motor-operated type, as it closes the jaws tightly every time.

A NOVEL ELECTRIC COIL WINDING MACHINE.

By Frank C. Perkins.

The accompanying illustration shows a novel electric coil winding machine developed at Boston, Mass. It occupies a floor space of 2 feet 6 inches by 2 feet 2 inches

Clever Machine That Automatically Crosswinds Magnet Coils of Self-Supporting Form.

and has a weight of 300 pounds. The driving pulley speed is 500 to 2,000 r.p.m. and it winds any length of coil. This electric coil machine is used for winding magnet coils by the Universal cross winding method, which has given excellent results in winding many forms of coils.

Valuable economic results have been secured through the use of the machine in winding coils automatically, in place of by hand or with somewhat crude mechanical appliances. It has been found that while for some kinds of magnets the cross-wound coil is admirably adapted, there are many forms of coil for which cross-winding is not adaptable. Experiments were begun in winding concentric coils, the wire being

Typical Crosswise Wound Coil, Made on Machine Above Pictured.

placed side by side similarly to spool thread. As will be obvious the difficulty with such coils arises from want of cohesion, without supporting heads. The element lacking was finally supplied by the addition of fine cotton yarn wound simultaneously with the wire, by the cross-wind system.

The coil thus produced is unique, and extensive use of this arrangement has demonstrated its value over the entire field of electrical magnets. The coils formed by the magnet machines are symmetrical, strong, compact and durable. These coils are wound either in cylindrical or in rectangular form, with or without cores. When wound without cores, they can be compressed into any desired shape without impairing their efficiency.

In winding this form of coil, a fine cotton yarn is interwoven with the wire, which may be either enameled or insulated with silk, cotton or other suitable material. The plane of the wire convolutions is at right angles to the axis of the coil, while the plane of the cotton strands lies obliquely to the axis, the entire mass being bound together so that the finished coil is practically indestructible either from external or internal stress.

In winding these coils the yarn is carried axially to a greater distance than the wire convolutions, thus forming an electrical and mechanical protection at both ends of the coil. After the requisite number of convolutions of wire have been made, the winding of the yarn may continue and entirely cover and surround the wire. The resulting coil is completely armored, similarly to a taped coil, rendering a separate covering operation unnecessary. In the winding process the yarn is so disposed that the convolutions of wire are slightly separated; and while a complete insulation between the several layers of wire is not obtained, there is secured a graded insulation which is thickest where the potential difference in voltage is highest.

It is stated that the amount of insulation may be varied, depending, naturally, upon the design of the coil. The interposing of the yarns between the layers and turns of wire facilitates the impregnation of the coils with the various insulating compounds. The mass of yarn between the layers and between the coils also forms a cushion, making an elastic coil, so that when high voltages or heavy currents are passed through, the coil is not ruptured or destroyed.

It has been found that the space factor is high and the air gap low, particularly so when this coil made of enameled wire is compared with coils wound with cotton or silk covered wire. In addition to the many electrical and mechanical advantages secured by this form of coil, a notable feature is the facility with which coils may be duplicated, giving exactly the same result in every coil wound. Coils wound as described have eliminated therefrom all defects, perfect units being produced.

It is of interest to note that the machine illustrated is automatic in operation. It is provided with a counter which can be set to the predetermined number of convolutions required, the machine stopping when these have been made, therefore insuring the same resistance and uniformity of size in all coils.

ELECTRICAL PRODUCTION OF OXYGEN AND HYDROGEN.

Oxygen and hydrogen are at present produced by two methods, viz., by the decomposition of potassium chlorate and manganese dioxide and by the decomposition of water by an electric current. The latter method is cheaper and a much purer gas is produced. The only substances needed for generating the gases is distilled water and a small quantity of potash for increasing the conductivity of the electrolyte.

Our photograph, Fig. 1, shows a commercial generator unit designed for generating the above mentioned gases. Each of these units is capable of delivering 3.2 cubic feet of oxygen and 6.4 cubic feet of hydrogen per mean hour and 4 cubic feet of oxygen and 8 cubic feet of hydrogen per kilowatt-hour.

These generators operate on 400 amperes at 2 volts D.C., or a little over one

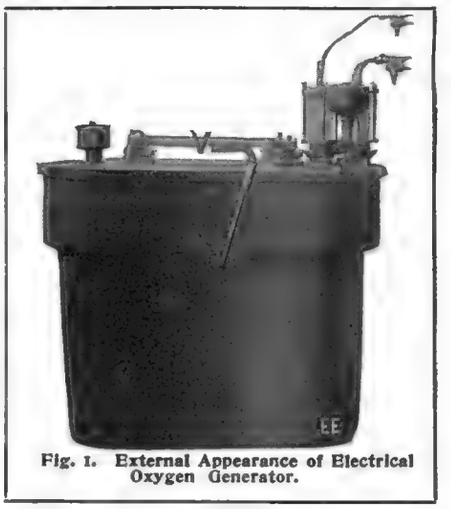


Fig. 1. External Appearance of Electrical Oxygen Generator.

horse-power of electrical energy. The gases are produced in compartments perfectly separated and, therefore, are very pure; the oxygen testing 99.6 per cent., while the hydrogen tests 99.8 per cent., which is undoubtedly pure enough for any use, even for medicinal work.

The generators are built entirely of iron. Fig. 2 depicts a schematic diagram of one of these units. At A is the oxygen off-take and at B the hydrogen off-take, which are connected to two separate glass tubes C, C, called the indicators and pressure equalizers. The negative terminal connects to the frame of the unit. The water is poured into the cell through cup F. In order that the gases do not escape into the air or mix up with each other within the cell, a hydraulic joint, G, is provided. The positive or anode pole is separated from the cathode by an asbestos dia-

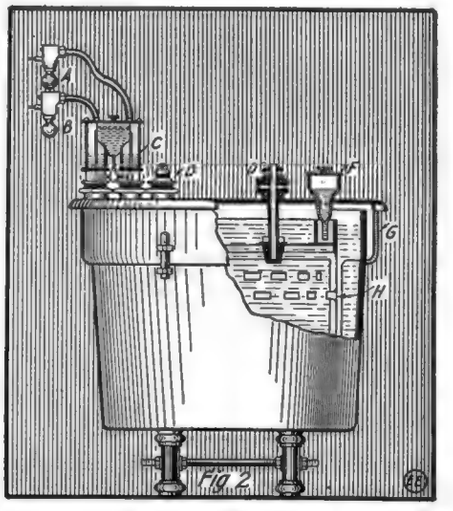


Fig. 2. Detailed View of Oxygen Generator.

phragm, H, which is porous. The complete unit is supported on porcelain insulators.

Photograph by courtesy of the International Oxygen Co., the builders of these unique generators.

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Mysteries of Matter

By John Candee Dean

WHAT do we actually know about matter today? What we partly know and what we do not know is covered at some length in the following discourse by Mr. John Candee Dean. Most of us have heard of or are somewhat familiar with the division of matter known as the atom. The electron is the latest sub-division of matter and an atom has been estimated to be 100,000 times as large as an electron. In order to bring the electron up to the size of Lord Kelvin's magnified atoms it would be necessary to magnify a drop of water to 100,000 times the size of the earth. Here is something to think about! For when all the peculiarities and characteristics governing the formation and activities of the electron are once known, then we shall be indeed a long way on the road to the solution of many scientific and industrial problems which at present have baffled our best technicians. The electron, according to the latest researches, apparently lives in a world all its own, which is as interesting in its study as the life of the average human.

IN the study of the vast, or of the minute, the imagination is incapable of comprehending the spaces involved. When we say that the sun is more than a million times larger than the earth, the statement does not present a mental picture of the sun's magnitude. A better conception of the sun's immensity can be obtained by saying that if the earth were placed in the center of a spherical shell, with a diameter equal to that of the sun, the moon's orbit would be a little more than half way between the earth and the shell of the sphere. But sizes of all things are relative. The magnitude of the sun is insignificant compared with some of the fixed stars. Professor Kapteyn estimates that the red star Antares, in the heart of the Scorpion, is 3,400 times as brilliant as the sun. The diameter of Antares is estimated to be 160 million miles, or nearly as great as the orbit of the earth.

We meet with the same difficulties in attempting to comprehend the spaces occupied by molecules, atoms and electrons. Lord Kelvin said that if we could magnify a drop of water to the size of the earth, the atoms then might appear to be somewhat smaller than cricket balls. The average atom has been estimated to be 100,000 times as large as the electron. Now to bring the electron up to the size of Kelvin's magnified atoms, it would be necessary to magnify a drop of water to 100,000 times the size of the earth.

For nearly 100 years Dalton's atom kept its place in the theory of the structure of matter. This atom was supposed to be the ultimate particle of matter, and stability was believed to be an essential characteristic of all the elements. At the beginning of the present century, the old theory of the indivisible atom, and of the stability of the elements, was upset by the discovery that certain rare elements were disintegrating, and changing, by throwing off particles much smaller than atoms. It must not be assumed that this discovery demolishes the atom. It does not. The atom continues to be the unit that enters into all chemical combinations. The hydrogen atom was formerly the smallest particle known to science. Now the smallest particle known to science is the electron, whose weight is one seventeen-hundredth part of the hydrogen atom.

Herbert Spencer said, in substance, that organic progress consists in a change from the homogeneous to the heterogeneous, and this law of progress is the law of all progress. He said, "From the earliest traceable cosmical changes, down to the latest results of civilization, we shall find that the transformation of the homogeneous into the heterogeneous is that in which progress consists." No two elements have atoms of the same size or weight, and each of the different elements has strong individual characteristics. Atoms are therefore heterogeneous, and according to Spencer's law they must have been evolved from a lower stage of matter. Now electrons appear to be absolutely homogeneous, since all electrons are of the same weight or mass, carry the same electric charge, and always turn out to be the same thing, regardless of the metal that forms the negative electrode, or the gas from which they are derived. Hence, according to the Spencerian law, they should be the primal substance from which matter is evolved.

Stability is no longer regarded as an essential characteristic of the elements. The element radium disintegrates by the explosion of its atoms. The primary elements subject to disintegration by atomic explosions are uranium, actinium and thorium. Radium is derived from uranium in consequence of its throwing off three atoms of helium. Hydrogen (1.008) is the lightest of the elements. Uranium is the heaviest. Its atom is 238.5 times as heavy as hydrogen. The atomic weight of helium is 4. Three atoms of helium would be 12, hence uranium (238.5) — helium (12) = radium (226.5). The atomic weight of radium is 226.4. The small difference is probably due to the loss of electrons during the change. Radium disintegrates by the breaking up of its atoms, each radium atom hurling off one particle of helium, and one of niton. The change is as follows: Radium (226.4) — helium (4) = niton (222.4). Therefore, the atomic weight of niton is 222.4.

The explosion of the atoms of radium appears to be as complete as that of a steam boiler; the whole of the atom bursts into gases. The light atoms of helium, that form, are shot into space with a velocity of more than 10,000 miles a second and the heavy residual atoms of niton acquire sufficient velocity, in consequence of the ejection of the helium, to escape and be deposited on bodies in the neighborhood. The expelled helium atoms are called Alpha rays. There is an inexpensive little instrument, called the Spinthariscope, which is arranged with a minute particle of radium in front of a zinc sulphide screen. On looking into the instrument one can see the helium atoms bombarding the screen, each atom producing a minute scintillation, the hundreds of points of light making the screen sparkle like the stars in the Milky Way. The helium atoms are so minute that the bombardment of the screen could go on for hundreds of years without any sensible diminution of the particle of radium.

Radium also emits powerful Beta rays, which consist of electrons flying out with a velocity of 100,000 miles a second, capable of penetrating thin plates of metal. A third radiation, called Gamma rays, originate in the impact of the Beta rays. They are really X-rays of such strength that shadow-graphs can be made with them through eight inches of solid lead. This radiating power is an automatic property which cannot be produced artificially. Radium is a very heavy metal. Heavier than gold, mercury, lead or any material with which we are familiar. It disintegrates very slowly. Its half period of decay is 1,760 years. If a gram of radium were put away for 1,760 years, only half a gram would remain at the end of that time; in 3,500 years one-fourth gram, and in 7,000 years one-eighth gram would remain. The half period of uranium is roughly estimated at seven billion years, while that of thorium, another radio-active element, at ten billion years. An attempt has been made to estimate the age of the earth from these slowly decaying elements.

As already stated, the emanation of radium is niton, an inert substance which forms no salts. Niton's half period of decay is only four days, and its emanation is changed to a new type of matter called Radium A. Each second a definite fraction of the number of atoms present break up, and the process of degeneration continues through a number of distinct unstable forms, called Radium A, B, C, D, E, F. Radium F is also called Polonium, an intensely radio-active substance with an atomic weight of 210.4. By throwing off one atom of helium its weight changes to a substance with an atomic weight of 206.4 which is close to that of lead, hence it is probable that lead is the final product of the radium series. Twenty-six so-called elements are derived from the automatic breaking up of uranium, thorium and actinium; 16 of which are formed by throwing off of helium atoms, and are therefore real elements. Ten are formed by the emission of electrons and therefore are allotropes or pseudo-elements. It is by the ejection of full-sized atoms that substances of different chemical properties and valency result. We frequently have our attention drawn to the enormous energy stored in radium and its emanations. Sir Wm. Ramsay states that the heat which niton parts with during its disintegration is equal to 3,500,000 times the energy available by the explosion of an equal volume of detonating gas. The principal part of this energy comes from the expulsion of helium atoms. He also says: "If radium were to evolve its stored-up energy at the same rate that gun-cotton does, we would have an undreamed of explosive, provided always that a sufficient supply of radium were forthcoming," and Sir J. J. Thomson startles us with the statement that the atomic energy stored in an ounce of chlorine, "Is about the amount of work required to keep the *Mauritania* going at full speed for a week." He further tells us that to split up an atom of one element into different kinds of atoms would involve enormous transformations of energy, "In fact the explosion of the atoms in a few pounds of material, might be sufficient to shatter a continent!"

The electromagnetic unit is an electric current of one ampere flowing for ten seconds. A 16 candle-power, 110 volt, carbon-filament, electric lamp requires a current

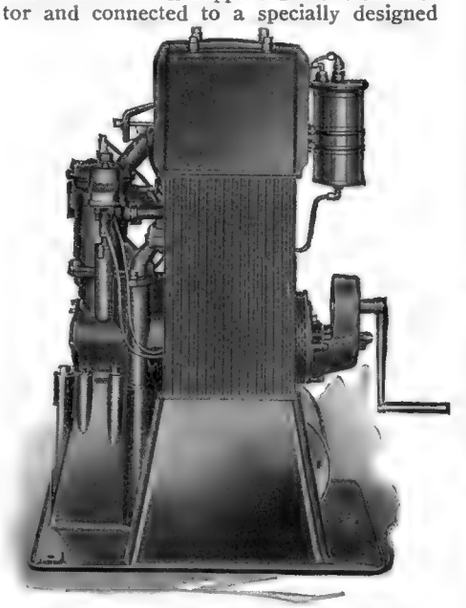
"UNI-LECTRIC" AN IDEAL PRIVATE LIGHTING SYSTEM.

A few years ago "private electric lighting plants" were rated as a luxury which only the very wealthy could enjoy. Now, however, the introduction of the "Uni-Lectric" lighting, cooking and power system has proved that not only is a complete electric lighting plant in domestic size available at a reasonable cost, but that it is available without the elaborate and complex mechanism of the ordinary individual electric system. Such being the case, it is expected that the "Uni-Lectric" will be the forerunner of a complete revolution in private lighting methods in communities where current from a central power station is not available.

The "Uni-Lectric" lighting system is a recent invention perfected by Warren Noble, well-known consulting engineer and designer. Its chief claim to distinction lies in the fact that the entire generating device is built in a single small and compact unit, 42 inches in height, 25 inches in length, and 24 inches in width. Hence the name "Uni-Lectric."

The device itself, which differs radically from anything else of the sort yet perfected, consists of a small four-stroke motor of the high efficiency type, operated by gasoline or other similar fuel, and direct-connected to a specially constructed electric generator. This generator develops a standard 110-volt direct current. It is cooled by a forced draft induced by fan blades on the flywheel of the motor, so that even when run for hours with an overload of 100 per cent. it will not overheat.

The fuel tank is supported above the motor and connected to a specially designed



The "Uni-Lectric" Lighting Plant is Very Rugged and Self-Contained, Comprising Dynamo and Gasoline Engine.

carbureter. The throttle is operated by a special electric governor regulating the speed according to the load and maintaining a constant voltage with all varying loads. The ignition is by high tension magneto with fixed spark.

No switchboard or batteries of any kind are used. No rheostat or volt meter is required. Two terminals are provided on the machine for attachment to the two feed wires leading to the lights. There is no possibility of misconnecting, as either wire may be attached to either terminal. The normal capacity of the machine is rated at 500 watts, with an overload capacity up to 600 or 800, so that from 30 to 60 Tungsten lights, depending on the wattage, may be carried on the line.

As designed the "Uni-Lectric" is said to be absolutely automatic and foolproof. It is started by a turn of the high-geared crank, and it is noteworthy that the starting gears are never in operation except when the handle is turned. The opening of the magneto switch stops the operation of the machine. All moving parts are inclosed. The motor and generator are so perfectly balanced that no foundation is required, and the machine need not even be bolted to the floor.

FRENCH DOG REPORTS BY TELEPHONE.

According to the *Gazette de France,* a certain French regiment possesses a dog which is sent out from advanced sentry posts at night with a telephone strapped over his mouth and a wire connecting the instrument with the post. If the dog hears the Germans approaching it barks quietly into the telephone.

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of one-half ampere. Therefore, such a lamp consumes one electromagnetic unit in 20 seconds. The agitation produced by the crowding together of millions of swiftly passing electrons gives rise to the brilliant light of the filament. The electric energy is so concentrated in the electrons that a mass of them equivalent to a mass of *one ounce* would light 300 of these lamps to their full candle-power, night and day, for a year.

In spite of the minuteness of atoms Rutherford has been able to detect the presence of a single atom of helium. He employed a partially exhausted vessel having a tiny hole, through which, by ingenious apparatus, single atoms of helium were shot. These atoms are expelled from radium with a velocity of more than 10,000 miles a second, striking and breaking up the gaseous molecules in the vessel, producing positively and negatively charged ions, which for an instant permit a current of electricity to pass. A current measuring instrument in the line records the entrance of the atom, enabling the observer to count each one as it enters.

We appear to be getting back to Franklin's single fluid theory of electricity. The electric current is believed to be a movement of negative electrons through a conductor, from the negative to the positive, instead of flowing from the positive to the negative, as was formerly supposed. Many scientists believe that negative electricity is the only kind. Positive electricity arises from a lack of electrons. For example, a positively charged helium atom is merely a helium atom that has temporarily lost two of its electrons. In theory the negative electron is not a particle negatively charged, but is in itself a negative charge. This is equivalent to saying that matter is wholly electrical. The electron enters into the structure of the atom, but is the weight of the atom due entirely to the mass of the electron? It is claimed that the electron has no mass in itself. Its apparent weight is due to the adhering ether which it drags along, as it shoots through space. It is like stirring a bucket of water with a cane, a small quantity of the fluid will temporarily adhere to the cane and be carried along with it.

Nature is more marvelous, more interesting and more beautiful than anything that the imagination can produce. The great French astronomer and scientist, Henri Poincaré, tells us that the scientist does not study nature because it is useful. He studies it because it pleases him, and it pleases him because it is beautiful. He says, "Were nature not beautiful, she would not be worth knowing, life would not be worth living. I do not mean here, of course, that beauty which impresses the senses, the beauty of qualities and appearances; not that I despise it—far from it; but that has naught to do with science; I mean that subtler beauty of the harmonious order of the parts which pure intellect appreciates."

It is a mistake to suppose that knowledge of breaking up of atoms into smaller particles originated with the discovery of radium. As far back as 1873 Sir Norman Lockyer suggested that many difficulties of the laboratory would vanish if we conceded that atoms could be broken up into much smaller particles. In 1890 he published "Inorganic Evolution as Studied by Spectral Analysis," in which he says, "Science now has to consider masses much smaller than the atom of hydrogen." In the study of the hottest stars he found himself in the presence of furnaces of transcendental temperature shielded by their vastness from the distracting phenomena which were present in the laboratory.

He classified the fixed stars in the order of their temperatures. Stars of the hottest class he called Argonian from the star Gamma of the constellation of Argo Navis, which has a temperature estimated by him at 50,000 degrees F. Gamma Argus contained a set of spectral lines not before recognized and he concluded that they indicated a new element connected with hydrogen. He called the new element proto-hydrogen, because of the relation of its lines to those of the proto-metallic lines. The Argonian stars are now called helium stars; they show but few elements. Proto-hydrogen, helium, asterium and proto-calcium are conspicuous. Lockyer tells us that the high temperature at which proto-hydrogen appears, is not the end of the simplification of stellar transcendental temperature. "The work of the dissociation of the atom carried on under our eyes in the hottest stars, is quite impossible in our laboratories." He says, "At higher temperatures the chemical units with which we work at low temperatures are broken up into smaller masses, explains the spectral phenomena observed, not only in our laboratories, but in the sun and stars. The final breaking up by heat must be the earliest chemical forms."

Heat is a motion of the atoms of matter, and a fall of temperature slows down this motion, but man's ingenuity has not yet brought a single atom to a state of rest. The temperature of a body varies as the square of the amplitude of vibration of its atoms. If all the heat of a body could be abstracted its atoms would cease to vibrate. Increase of heat accelerates atomic motion until a critical velocity is attained that overthrows the affinities which hold the atoms in chemical combinations. At a temperature of 4,000° F. the existence of water is no longer possible, not even in the form of steam. Its molecules no longer cohere, because of their energetic motion, and they dissociate into hydrogen and oxygen gases.

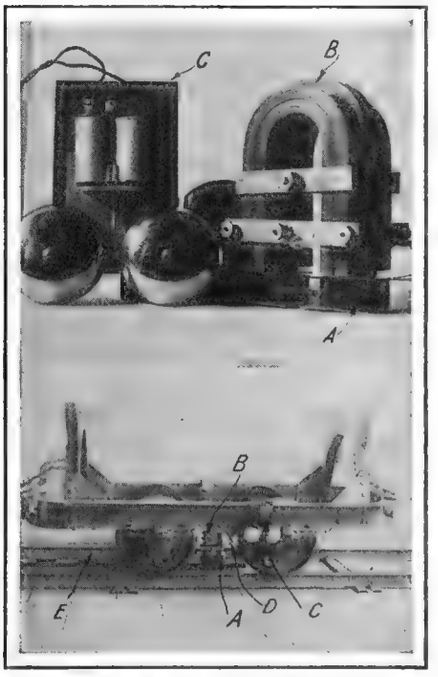
The heat of the sun is probably sufficient to dissociate all chemical combinations, consequently interior solar matter is in its monatomic, or elementary condition, and much of it may be in the electronic state. Perhaps there is a critical or maximum temperature for all matter, where the violence of the motion of clashing atoms causes them to break up into electrons. In stars of the highest temperature like Gamma Argus, or Zeta Puppis, the critical state has probably been reached and the greater part of their matter is in the form of electrons. When matter is in its hot-

(*Continued on page* 590.)

New Electric Signal for Locomotives

The subject of safety on railway trains is of vital importance, especially at present, when railroad travel is more extensive than it has ever been.

The main cause of accidents which arise now and then is due mainly to the negligence on the part of the engineer or switchman, and sometimes also to the improper working conditions of the semaphore. The cause is due to the engineer in that he does not watch carefully for signal blocks, although sometimes this is not rightly called the fault of the engineer, as it is often necessary for him to adjust some device in the locomotive cab while the train is in motion. Consequently his attention is drawn away from the road, which may mean a wreck or collision.



Above (Fig. 1): Shows Details of Magneto Ringer for Locomotive Signal. Below (Fig. 2): How Signal Bell Is Attached to Locomotive Frame.

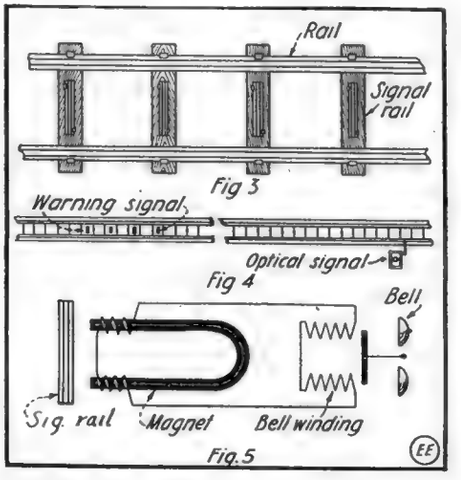
Suppose now a device is installed on the track before the block signal is reached, say about a mile or so, which, when the train reaches it, will cause a bell to ring in the cab, thus calling to the attention of the engineer that he is approaching a block and should be on the lookout for the signal which informs him of the condition of the road, of course.

Various devices have been developed in the past for arresting the attention of the man driving the locomotive, but none of them have proved a success, as they invariably employed contacts on the engine and track, and also some means of supplying current, such as batteries and dynamo. Now everyone knows that whenever batteries and sliding contacts in any electrical instruments are used that the condition of it will not be absolutely reliable. Practically all the devices for calling purposes on railways being employed to-day are impractical, due to the fact that they use sliding contacts and batteries or a generator, which require a great deal of care to keep the instrument in proper working condition and to which very little time can be given in railway work, generally speaking.

Now every student of electricity knows that whenever an electro-magnet is connected to a galvanometer and its field disturbed by some magnetic body, either by revolving same near the electro-magnet or by drawing it to and away from it, this action on the electro-magnet will cause a current of electricity to be produced in the winding, and this will in turn act upon the needle of a galvanometer. This is the exact principle upon which our present dynamos work.

This principle is used advantageously by A. Christian Berger (the originator and inventor of the submarine wireless system which was described in the August, 1915, issue of this journal) in developing a new electric railway signaling device, which employs only three simple parts and which does not, moreover, require any attention, as there are no sliding contacts or batteries used. His apparatus, which is shown in Fig. 1, consists of an electro-magnet A mounted on the poles of a powerful steel permanent magnet B. The electro-magnet is connected to an alternating current bell C (being of a type that does not employ any contacts), but which operates on the change of direction in the current.

The generating magnet A is placed underneath the locomotive as shown in Fig. 2, which is a photograph of an experimental train utilizing Mr. Berger's invention. The alternating current bell C is connected to magnet A by means of a wire D. The flux in the generator AB is changed by a series of iron strips E, laid between the track as perceived. In practise a number of short pieces of standard rails are laid in the center of the track and at right angles to it, as shown in Fig. 3, which is a schematic drawing of the track. The operation is as follows: When the train is passing over these intermittent center rails the magnetic flux in the electro-magnet is increased and decreased successively, thereby producing an alternating current in the coil, which in turn operates the polarized bell. The faster the train passes over these rails the stronger the bell will ring. If the number of rails is increased the same effect is produced. As will be seen, the operation is simple, neither contacts nor batteries are employed and there is nothing to wear out. The location of these rails would depend upon the condition of the roadbed. Fig. 4 shows diagrammatically the position in which they are placed. The connection of both of the instruments is depicted in Fig. 5.

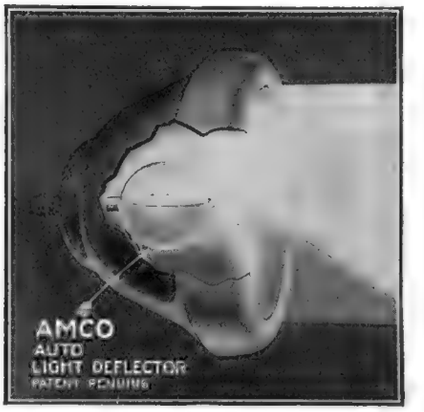


How the Berger Magneto Locomotive Signal Operates. Changes in Magnetism Ring Bell. No Battery Used.

This is another achievement in the development of apparatus for the prevention of accidents. "Safety first."

NEW AUTO HEAD-LAMP REFLECTOR.

The blinding glare produced by automobile headlights has been the subject of much discussion and legal argument. In some cases there have been passed ordinances controlling this problem. To reduce the blinding glare so produced, which has been the cause of many otherwise avoidable accidents, there has been recently marketed a unique device shown in the accompanying illustration. This consists of a hemi-spherical shell enameled white inside, which readily snaps over the electric light bulb in any such headlight. Its function is to deflect all the light rays to the upper half of the lamp reflector, thus throwing them outward and downward. It is guaranteed to meet the requirements of all State laws and regulations, and has received official sanction by the department of motor vehicles for the State of New Jersey. It should find general and extended use by all motorists, as the price is very nominal indeed, and as is generally known, the owner of a motor car does not care to spend any more than is absolutely necessary on such attachments as these.



Novel Auto Head-Lamp Shield to Reduce Glare.

ARMY PURSUES BANDITS WITH WIRELESS.

With the arrival at Mission, Texas, of Company B, Signal Corps, from Texas City, the American border patrol forces in the Lower Rio Grande Valley were able to pursue bandit raiders with the aid of wireless, it was announced at Fort Sam Houston.

Company B has four sets of portable wireless telegraph outfits, and there are already three pack trains in the Brownsville district. This will make it possible for Colonel Blocksom, commanding the district, to station one detachment of the signal company with a wireless outfit at Mission, the operating center of recent trouble, and have three detachments, each with wireless and pack train detail, ready for immediate field service.

The advantages of the new system of communication can hardly be estimated. Wire service, both telephone and telegraph, in the district is quite limited and even this has been often disabled by the raiders, who cut all wires as a preliminary to attacking any section. The result has been that while there have been an abundance of troops in the field for several weeks, they have been unable to surround a single band of raiders and prevent their escape because of the lack of communication and the densely brushy character of the country.

Do you know of some interesting electrical device, appliance or machine in your vicinity? Why not send us a picture of it?

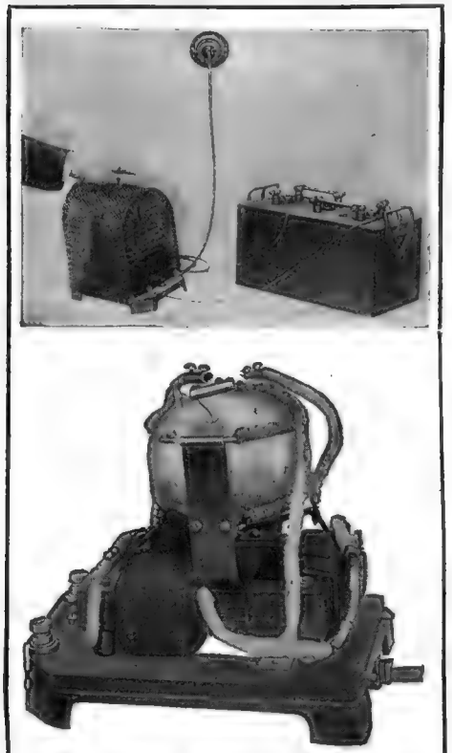
MERCURY ARC RECTIFIER FOR CHARGING SMALL BATTERIES.

A new and inexpensive mercury arc rectifier is just being marketed by one of the large electrical manufacturers for charging small storage batteries, such as those commonly used for starting, lighting and ignition current in gasoline automobiles and motor boats, for operating electric bells, for electro-plating and for numerous other uses where not over 5 amperes, 15 volts direct current is required and where only alternating current is available.

The new rectifier consists of a metal base, on which are mounted the necessary reactance coils and the rectifier tube in a suitable cover, the whole being encased in perforated sheet metal. It is designed for charging one three-cell, one six-cell or two three-cell batteries as required, and is automatic in that it is self-adjusting to any of these three conditions. In fact, the rectifier may be connected to a single-cell battery and will charge it at the rate of approximately 6 amperes from 110-volt alternating-current supply.

This type of rectifier is furnished for 60, 50, 40, 30 or 25 cycles, 110-volt alternating-current circuits. It is exceedingly compact, the outside dimensions being, roughly: Width, 6½ inches; depth, 9½ inches, and height, 11 inches. The total weight of the 60-cycle rectifier is approximately 15 pounds; therefore it may be transported from place to place in a garage, rendering unnecessary the removal of the battery from the car.

The rectifier is completely self-contained and requires no mechanical ability either to install or operate it. It is so designed that it will maintain a fairly constant current as the voltage of the battery rises. It is very easily started, simply by screwing the flexible lead attaching plug with which it is furnished into any convenient alternating-current lamp socket and connecting the two



Above: Compact Mercury Arc Rectifier Charging Ignition Batteries, etc. Below: Appearance of Arc Bulb and Reactance With Cover Removed.

binding posts, distinctly marked plus (+) and minus (—), to the corresponding terminals of the storage battery to be charged. After the alternating-current supply has been turned on by the socket switch the rectifier is tipped slightly by means of the handle on the top. The mercury "arc" will then start, alternating current will be converted into direct current, the battery will begin charging and the apparatus requires no further attention until the battery is entirely charged.

The cost of charging either a 12-volt (six cell) or two 6-volt (two three-cell) batteries for a 10-hour charge is about 13 cents, or the same for a single 6-volt battery. This cost is based on a rate of 10 cents per kilowatt-hour for current. Where the rate is less, the charging cost will naturally be proportionately lower. This cost is exceptionally small when compared with the usual cost of at least 50 cents for charging a 6-volt battery and 75 cents for a 12-volt battery, and there is the added convenience of being able to charge on the ground. This rectifier should thus become very popular with public and private garages where only a few batteries are to be charged.

Automobile Storage Batteries Withstand Fire

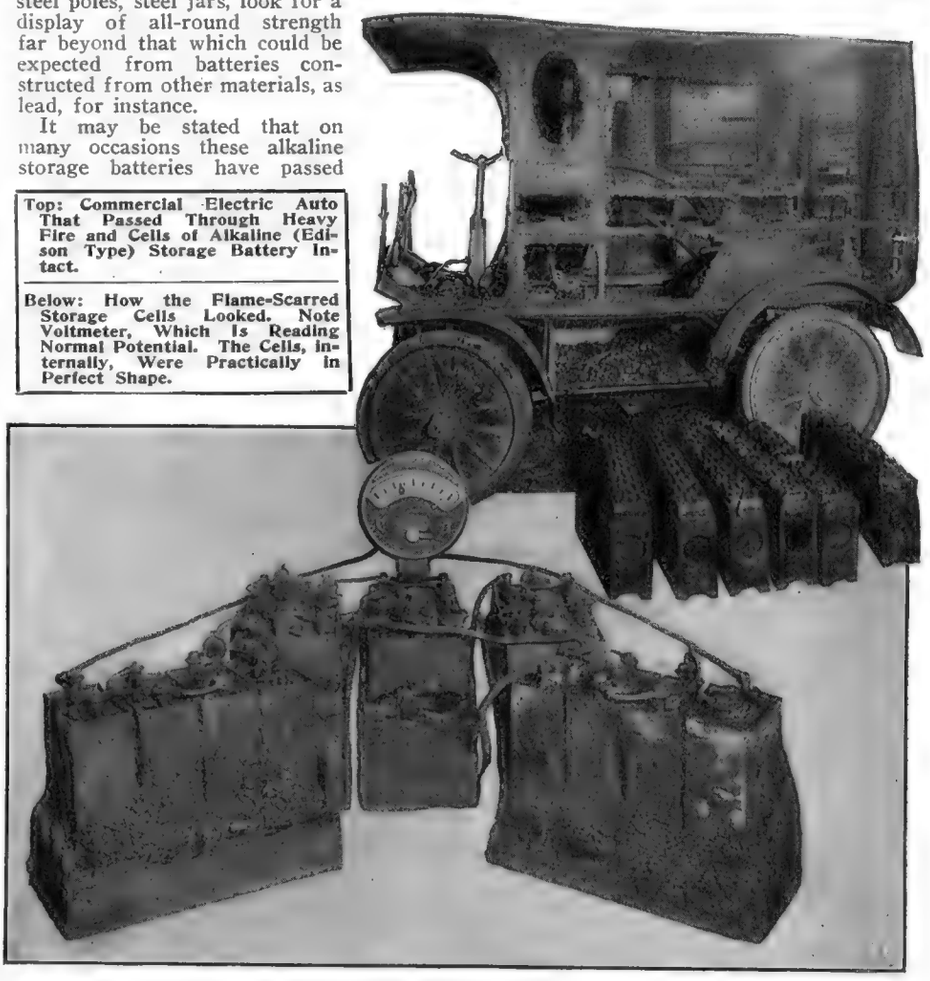
By Frank C. Perkins

THE accompanying illustrations show the result of a severe test of an automobile storage battery under most abnormal conditions, and proves that Edison storage batteries are most rugged. Those who use them and are acquainted with their steel construction, steel plates, steel poles, steel jars, look for a display of all-round strength far beyond that which could be expected from batteries constructed from other materials, as lead, for instance.

It may be stated that on many occasions these alkaline storage batteries have passed through fires that have completely burned the wooden trays in which they were assembled, and which have even melted some of the hard rubber insulation. Capacity for such abuse has never been chronicled in storage battery history until the advent of this cell. Many of these experiences have resulted in only a temporary decrease in efficiency instead of complete annihilation, and after making a few necessary repairs the battery has been returned to work better than new. One instance of this was a fire in Indianapolis, a short time ago, that burned a garage to the ground. The next morning the "electric" was run from the ruins on power supplied from its batteries, even though the body of the car was burned and the wooden trays in which the cells were assembled were badly charred.

When the garage of the Electric Light Co. of Cambridge, Mass., was burned and its contents practically destroyed, the remains of one alkaline battery-equipped truck were still serviceable and, with the exception of two cells in this Edison battery, none were beyond repair; in fact, practically nothing had to be done except insert new rubber parts when the cells were recanned.

It is said that all of the bushings and hard rubber insulators of the battery were totally destroyed. However, the connectors had not become loose and there was sufficient charred insulation in place to permit a test. Twenty of these cells when so tested showed an average of 1.3 volts, and the current available in the battery was sufficient to turn a No. 14 wire red hot in a few seconds.



Top: Commercial Electric Auto That Passed Through Heavy Fire and Cells of Alkaline (Edison Type) Storage Battery Intact.

Below: How the Flame-Scarred Storage Cells Looked. Note Voltmeter, Which Is Reading Normal Potential. The Cells, internally, Were Practically in Perfect Shape.

A Telephotograph in the "Movies"

The wide-awake spirit permeating the motion picture of to-day is strongly exemplified in one of the late Pathé films illustrating the episode, "The Disappearing Helmets," from the story of the "Romance of Elaine." The photograph reproduced herewith shows one of the leading characters in this extremely interesting film story, known as Prof. Arnold.

Exciting Movie Scene in Pathe Film, When Prof. Arnold Makes Use of the "Telephotograph."

He is here observed making good use of one of the latest developments of science, or the "Telephotograph," the machine that transmits and reproduces a photograph over a wire.

The film views showing this apparatus in operation are particularly well arranged, especially with respect to the color scheme in the original reproduction.

The photographs transmitted and reproduced over the telephotographic apparatus are, as is generally known, made up of a series of parallel lines closely spaced, and these lines, by their variation in thickness, etc., enable the reproduction of a built-up sketch of photograph. It is now possible to do this work in the laboratory (Dr. Korn's method); but as yet practically no commercial applications have been made, at least in this country, of this remarkable scientific achievement.

Photographs were transmitted over a wire circuit 500 miles in length, between Monaco, Italy, and Paris, France, for use in a Paris daily newspaper several years ago, utilizing Dr. Korn's system.

UNCLE SAM SILENCES TWO AMATEUR WIRELESS PLANTS.

Amateur wireless telegraph operators in the Great Lakes district have been under secret surveillance by officials of the United States Government.

Two licenses have been suspended, nominally because the equipment exceeded in power and sending capacity that permitted by Federal statutes.

One of these suspended stations was in Wilmette, within easy range of the big Government towers at the Great Lakes Naval Training Station, to which are sent many secret dispatches governing army and naval affairs.

No confirmation could be obtained from the Federal radio inspector's office as to whether this activity followed the persistent reports along the north shore than Government officials were investigating persons suspected of being spies for foreign governments.

It was declared that the instrument used by Charles A. Burgy, Jr., in Wilmette had a working radius of 75 miles and used a wave more than 340 meters in length, whereas the greatest permitted to amateurs is 200 meters.

The license of John D. Speicher, 4155 Grand boulevard, was revoked because his instrument also exceeded the limit.

"If these amateur instruments are allowed to operate without restriction," said Charles Blankenship, the Chicago radio inspector, "they will grow to a point where they might interfere seriously with Government regulation.

"Also, suppose a ship on the lake got into trouble and started an 'S-O-S' call for help. Then let one of these powerful instruments try to send at the same time. The usefulness of the ship's instrument might be available for only a few minutes, and disaster follow.

"We have checked up on many of these instruments. We will get after the others at once. Amateurs should understand that it is a dangerous proceeding to violate the statutes."

Especial attention is to be paid the operators who complete their message by any of these signs:

9 CT	9 YH	9 KS
9 OW	9 JP	LW

Complaints have been made that all of them exceed Federal regulations. Several other operators, unlicensed, whose messages have been caught and reported, are being searched for.

SOMETHING NEW IN ELECTRIC WASHERS.

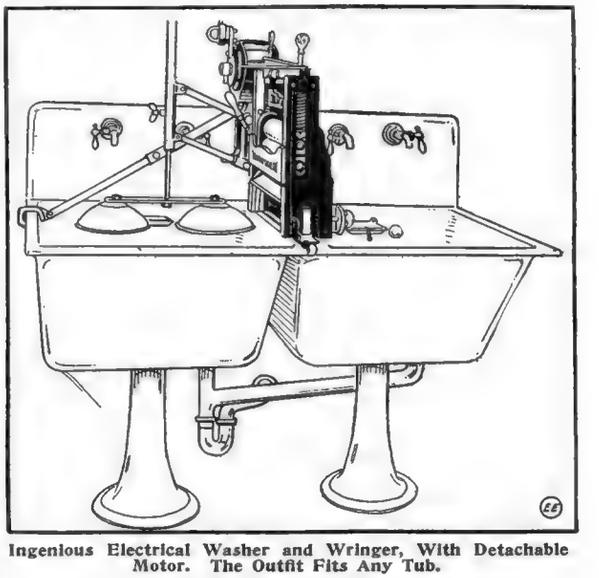
By Frank C. Perkins.

The accompanying drawing shows an effective electric washing machine embodying many new and radically different features, developed at Los Angeles, Cal. This machine washes, wrings, rinses and blues in any stationary tub and eliminates all handling of water by the operator—the plumbing fills and empties the tub for her. Being mounted on the stationary tub, the machine is entirely out of the way; yet it is always ready for use, and avoids all "getting ready" and "putting away."

It is of interest to note that the well-known vacuum principle of washing is utilized. The smooth vacuum cups wash clean, clear through, without injury to the fabric, and anything from the most delicate and sheerest laces to rag-rugs, heavy bedding or blankets can be washed without tearing. The operation is extremely simple. One operating handle, by a slight movement one way or the other, governs the action of the wringer or washer.

To reverse the wringer the electric motor is reversed by means of an ingenious four-point attachment plug. This reversing it electrically instead of mechanically eliminates the complicated gearing otherwise required. Safety of operation is provided for by enclosing the mechanism; by a safety pressure release on the wringer, whereby pressure can be instantly removed from the wringer rolls, and by the four-point attachment plug, which may be quickly detached, stopping the washer or wringer immediately.

This electric washer has a worm-and-gear mechanism, running in ball bearings, with ample lubrication, which reduces friction and wear to a minimum. By loosening a thumbscrew the motor may be removed for other purposes. Simple accessories facilitate its use as a sewing-machine motor, or to operate small grinding or buffing wheels and save the cost of the additional motor usually required with such apparatus.



Ingenious Electrical Washer and Wringer, With Detachable Motor. The Outfit Fits Any Tub.

WIRELESS PLANT AT COOS BAY, ORE., ASSURED.

The removal of the Government wireless station at Cape Blanco to Coal Bank Inlet, near the entrance to Coos Bay, has been assured with the announcement that a five-acre site had been purchased by the Marshfield (Ore.) Chamber of Commerce. The site will be deeded to the Government.

HAWK GROUNDS ELECTRICAL TRANSMISSION LINE.

The illustration herewith shows the remains of a common hawk which some time ago flew into eternity through the transmission lines of the Public Light & Power Co., of Chattanooga, Tenn., near the lock and dam on the Tennessee River. During a storm in the valley of the Tennessee River the hawk, which measures five feet from tip to tip of his wings, either flew into the circuit or, alighting on one phase, stretched his wings, making contact with one phase and the ground wire, which is three feet from the nearest phase.

Hawk That Grounded High Tension Wires Besides Causing Its Death.

The line in question operates at 44000 volts, and it cost the company approximately $15 to remedy the trouble after it was located. Occurrences of this kind, while common in some sections of the country, are rather rare in the Tennessee River valley, but no matter where they occur they are beyond the control of transmission companies, a fact oftentimes lost sight of by the general public, which may be temporarily inconvenienced because of the failure of a transmission circuit from such cause. Some years ago a similar case occurred on a Western high-tension transmission line, in which a bobcat played the leading rôle. Being chased the animal took refuge in the high voltage line and, needless to say, he got the surprise of his life. One blinding flash announced the grand finale of his existence.

NEW RADIO SECRECY SCHEME TRIED BY U. S. NAVY.

Sending of radiograms by vessels at sea without revealing even the approximate location of the ship dispatching the message —a problem which has confronted naval strategists since the discovery of wireless communcation—virtually has been accomplished. Experiments of that order made by the "enemy" divisions of the Atlantic fleet during the recent war game were said by naval officials recently to have been highly satisfactory.

During the time the two forces were engaged in the maneuvers, one moving to attack the coast and the other to defend it, the vessels were in constant communication with the navy yards and supply stations ashore, but neither force was able to determine the location of the other by the use of the wireless.

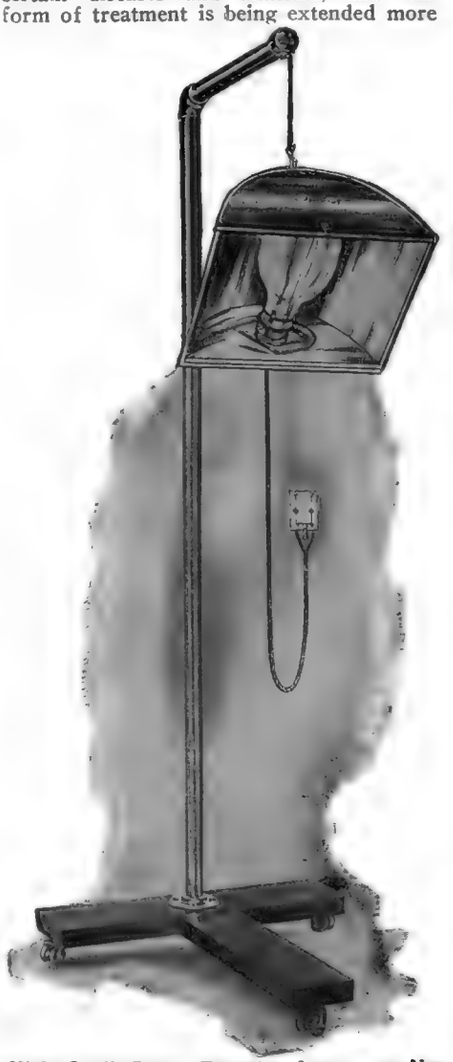
The messages were disguised by means known only to the Navy Department, and, for the first time in the history of the war game maneuvers they gave the vessels intercepting them no indication as to where they came from or what force of wave length had been used in transmission.

Ordinarily, naval officers say, an experienced operator can estimate the location or proximity of a vessel by listening in or receiving messages it is sending.

LARGE TUNGSTEN LAMPS USED FOR ELECTRO-MEDICAL TREATMENT.

The illustration presented herewith shows the arrangement of a large-size electro-therapeutical treatment lamp comprising a high candlepower tungsten lamp, which consumes from 500 to 1,000 watts. The lamp comes mounted in a suitable reflector. A flexible cord and plug connection is supplied with the lamp for insertion in a wall pocket. The reflector and lamp may be moved up or down to any required height by a specially arranged balancing scheme, the weight for which slides within the hollow upright standard, which is in turn mounted on a substantial pedestal. The pedestal is suitably mounted on casters so as to permit moving the treatment lamp about as required.

It has lately been found that treatment by the rays given forth by such a high candlepower lamp is of great value for certain diseases and ailments, and this form of treatment is being extended more and more every day as its efficacious properties become more widely known to the medical profession.

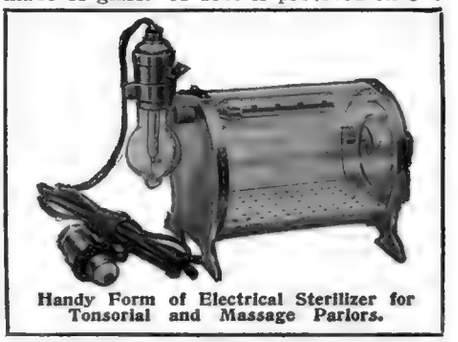


High Candle-Power Tungsten Lamps are Now Widely Used for Heat and Ultra-Violet Ray Treatment by Physicians. Adjusts to Any Position.

Their effects are not unlike the effects from sunbaths, in fact they really take the place of the sun for all practical purposes in the treatment of skin diseases.

ELECTRIC STERILIZER SOLVES MANY PROBLEMS.

A new electric sterilizer has been recently put on the market by a New York concern. This new sterilizer is herewith shown and consists of a gas-tight cylinder made of glass. A door is provided on one end, as perceived, and is supplied with a rubber gasket for making it absolutely air-tight when it is closed.



Handy Form of Electrical Sterilizer for Tonsorial and Massage Parlors.

The vaporizer, which is enclosed in the glass chamber, as seen on the upper left hand corner of the apparatus, consists of a glass bulb made similarly to an incandescent electric lamp, but it contains two wires, which are not connected to each other and thereby form two entirely distinct electrodes. These are immersed in a liquid which forms the electrolyte between the two electrodes.

A small hole is provided on one side of this bulb, into which the liquid is poured and whereby the gas escapes when the electrolyte is decomposed by the electric current. The liquid used in this vaporizer is so made that when it is decomposed it liberates a gas which is highly germicidal and consequently kills any germs that it attacks. The apparatus is a complete unit by itself and can be readily removed by unscrewing it from the screw socket as depicted.

This electro-formalin sterilizer is very efficient and it will undoubtedly find its way into hospitals and especially into dental laboratories, where surgical instruments are in constant use. It can also be used in the home for sterilizing rubber goods, such as babies' nipples, etc., and other various things which need constant sterilizing.

HAWKEYE RADIO ASSOCIATION OF LAMONI, IOWA.

The Hawkeye Radio Association held its annual convention on Sept. 1 and 2 at Engineering Hall, Iowa State College, at Ames. Officers for the year 1915-1916 were elected as follows: President, Ralph Batcher; secretary, Arthur B. Church; treasurer, Hollis Sels. After the general business was finished several talks were given by the new officers and club members, in which some very interesting suggestions were offered. A large assortment of apparatus from various companies was on display and tried out, several new instruments giving remarkable results, especially the new amplifying receivers but recently placed on the market. The convention adjourned with its members feeling highly satisfied with the good time they had had and the large amount of information collected. All wireless operators in Iowa should not fail to join this association, as the use of the club's testing instruments alone is worth more than the entrance fee. Communication with similar organizations is invited. Address the Secretary, Arthur B. Church, Lamoni, Iowa.

The housewife would appreciate an electric iron more than the vote. Take a hint Mr. Man.

The Shirikari Tentacle

By George Frederic Stratton

TWENTY-FOUR hours after the marvelous Poniatowski Ray had put the Japo-Chinese fleet in Cisneros Bay out of commission, Cawthorne, the young millionaire who had backed the inventor with both money and enthusiasm, was on a special train going north. With him was Kilroth, his mechanician, and between the only passenger coach and the locomotive was a box car containing two of the Poniatowski projectors which they were taking to install on one of Admiral Sorensby's vessels in San Diego Bay.

They had crossed the Arizona border at Nogales and there saw the first American newspaper they had seen since they had operated the new Gravitation Nullifiers on the Mexican side of the Rio Grande. And what they now read was as amazingly startling as any of their own exploits had been.

ADMIRAL SORENSBY'S FLEET ATTACKED BY SOME MYSTERIOUS AND UNSEEN FOE

Submarines Crippled and Battleships Thrown Into Confusion.

CONSTERNATION IN WASHINGTON

(*Special to The Nogales Star.*)

WASHINGTON, Aug. 10.—Information has just been wired to the Secretary of the Navy that during the last twenty-four hours three submarines cruising in San Diego Bay have come to the surface and displayed distress signals. Upon help reaching them it was reported that the boats and equipment had suddenly become charged with an electric current so powerful as to cause severe shocks to the crew when they came in contact with any metal. Two of the men on the S-3 were killed outright. On all three boats this astounding attack of uncontrolled electricity burned out the motor armatures, disabling the boats.

The battleship Idaho felt the same mysterious influence. For fifteen minutes she was practically out of control, because of the helplessness of the crew. Her wireless antenna and equipment was instantly burned out. Then the shock left as suddenly as it had occurred.

The weather was perfectly clear, no atmospheric disturbance being evident, and it seems impossible that any action by the enemy could have caused the trouble, as although the reserve Japo-Chinese fleet is on its way across the Pacific it is known by scout-aeros that it is over a thousand miles away. There is not a submarine in the Bay except those under Admiral Sorensby's command, and no aeroplanes have been seen for ten days.

Ned Cawthorne read the account a second time and then muttered to Kilroth: "What do you make of it, Billy?"

The inventor-machinist had no answer ready. His eyes dwindled to pin-points and peered vacantly at the big mogul which was backing down to couple onto their cars. After a pause he shook his head and grunted:

"It's beyond me, Cawthorne. Looks as if they'd been connected up to some very high-voltage current—but, how? No attempt to send a high-power current by wireless has yet succeeded."

"Humph! How about that Hammond torpedo boat? That's been doing wonderful work under wireless control, Kilroth. And the Japs tried, before the war, to buy all information and plans."

"It's wireless control only, Cawthorne. It carries its own power with it and, more than that, it's not a submarine. It operates in plain sight. Nothing of that type can be in San Diego Bay. There's some new scheme afoot, or afloat; but I haven't the faintest glimmer of an idea what it can be!"

* * * * * * * *

When they reached the Bay they found that the consternation had increased tremendously. A large number of the forty submarines were tied up with burnt-out motors; among them were six of the Cawthorne Omegon vapor boats which had so successfully attacked the enemy's dreadnoughts outside San Francisco.

Cawthorne and Kilroth were ordered to the flagship to consult with the Admiral on the disposition of the Poniatowski tubes, and while on board they had a full demonstration of the mysterious current. They were in the Admiral's cabin when a report came over the bridge telephone:

"Admiral! The ship is electrified. The men are——" Then with a crash in the receiver the communication stopped.

They rushed out to the main deck and saw officers and crew carefully avoiding any contact of their hands with any metal. Cawthorne placed his hand on a steel guy as he hurriedly passed it and instantly fell to the deck severely shocked. The vessel was at anchor and in smooth water, so that no orders for immediate operation were necessary.

Round the side of the turrets laid five deck hands dead. They had been swabbing down the deck and were in bare feet, which exposed them to the full force of the mysterious current when they had come in contact with the turret. Cawthorne had regained his feet, assisted by one of the officers, and, shaking in every fiber, glanced about him. Men were crouching strictly aloof from any article except the deck on which they were standing, and evidently too terrified to make any movement. The Admiral stood grasping the hempen falls of a boat tackle and listening to the report of the deck officer.

"The conditions are exactly the same, sir, as have been reported from other ships. It is impossible to handle any equipment of metal. In the engine room the stokers are crouched on the coal. It would take a winch and tackle to draw them off that."

The bewilderment, indignation and disgust on the Admiral's face were supreme. "Signal the *Minnesota* to send her diving crew and outfit over here at once! Let their launch lay away from the ship and the diver search below and around for any indication of concealed wires or torpedoes!"

The officer hesitated. "Our wireless is destroyed, Admiral! We shall have to use flag signals."

"Do so, sir. Stay! Is it possible to operate that starboard launch?"

The officer cautiously looked over the rail at the launch moored at the end of the boat-boom and hailed a man aboard her:

"Below there! Are you feeling any of the current among your machinery?"

"No, sir. None at all."

Lieutenant Barlow turned to the Admiral. "She can be sent away, sir, if we can get a crew aboard. But no man can reach her by the ladder."

"Hoist a man over the rail by a tackle!" commanded Sorensby. "Drop him in the water and he'll probably be safe from the current and can reach the launch. Two men can handle her."

This was gingerly and very deliberately done and in a few minutes the launch motor was started and the boat darted away to the *Minnesota* with the Admiral's order.

But before she had covered half the distance the strange electric current left the ship. In a moment everything was in its normal condition and, responding to a sharp order, deck hands were carrying the dead men below. Then again came the shock, tumbling men to the decks—some never to rise again. This time the Admiral, ascending the ladder to the bridge, was plunged down severely bruised and shaken.

The second attack lasted less than a minute, but the demoralization it caused was complete. Had one of the enemy's vessels appeared at that minute—even an unarmored collier—no offensive action could have been taken against her. Not a single gun could have been operated or fired.

* * * * * * * *

Two of the speediest light cruisers were to receive and operate the Poniatowski ray projectors, and on the day following the attack on the flagship Cawthorne and Kilroth had superintended the loading of the tubes onto a barge. As they steamed out to the cruisers they gazed at the group of great dreadnoughts lying at various anchorages, faint streams of smoke lazily curling from the funnels.

"There's a vessel apparently aground over there!" exclaimed Kilroth. "I noticed her yesterday. She's not one of the fleet, I guess. Looks like a tramp freighter."

"That's what she is, sir!" exclaimed one of the barge hands. "The *Aratusa*, from Manila to San Francisco. She went aground on the Chulavis Bar a week ago with a cargo of sugar. They say she's waiting for lighters."

They ran alongside the cruiser *Trenton* and hoisting tackle was rigged to transfer the big twenty-four-foot ray tube. It was hoisted above the deck and the hands were swinging the derrick around previous to lowering when the appalling current again attacked the vessel. Ropes were dropped as men recoiled in horror. At the winch the attendant at the gear clutch shrieked as he dropped away from the lever, and the winch, still operating without control, ran the great aluminum tube up against the

IN this remarkable story Mr. Stratton shows how a Dreadnought is put out of action by means of a certain electric current directed to the ship by an enemy. If this story does not sound plausible to you, because of the feature where the electric current is sent to the metallic hull of the ship, which would apparently short-circuit with the ocean, kindly consider this: The body of an electric eel is a first class conductor, so is the water in which the fish lives. Nevertheless the fish without killing itself, can kill a horse, if it touches the latter in a vital spot. Although the fish, the water and the horse are "short-circuited," the current sent from the fish is able to kill the horse, without harming itself. Our most able electricians have as yet not solved this apparent paradox.

collar of the derrick boom. Kilroth saw what would happen and sprang to the clutch lever, but was thrown as he grasped it, and the next instant a ripping, tearing crash accompanied the smashing away of the collar and the ray tube slipped down

But on the barge one discovery had been made. Jake O'Shea, a deck hand, who had jumped from the cruiser, had gone deeper than he expected and as he came up and swam to the barge a fine wire was twisted around him. It was about fifty feet long

treatment he had once revived for a few moments and gasped: *"The Tentacle! The electric Tentacle!"* and had then again lost consciousness. Whether he really knew anything of such a contrivance or had become obsessed or perhaps insane over the

" * * * Tiny Submarines * * * They Run Out with a Fine Composite Wire Cable, Through Which They Are Directed and Through Which That Current Is Shot After They Fasten Onto Their Prey * * * "

onto the ship's rail and from there into the water, instantly going to the bottom.

The *Trenton* sustained the longest attack of any vessel of the fleet up to that time. When the current went off she was practically out of commission. Except that her wireless equipment and all her motors were burned out, she had sustained no damage, but her crew was uncontrollably frantic. The cap of the rail was of wood and half of the men had vaulted over that into the ocean and swam to the barge, which had cast off her lines and drifted away. Of the other half several had been killed outright; others were so severely shocked as to be almost incapable of action or reason.

Flag signals reported the calamity to the Admiral, who signaled back: "Send the barge ashore immediately with orders to unload the other projector and store it in safety!"

Cawthorne breathed a great sigh of relief as he heard that order. Although he growled to Kilroth: "This is the first time that one of our devices has had to beat a retreat!" he cheerily said to the Captain:

"That tube will operate just as effectively from the land as from a vessel. She'll project that ray for twenty miles and that'll catch any enemy that comes into the bay."

"What if that unknown electric current should get into operation on shore?" retorted the Captain.

Cawthorne winced. Not one guess—not a particle of theory had any of the officers or engineers of the fleet expressed as to that mysterious and appalling agent and, knowing nothing of its origin, no idea of its limit could be evolved.

and at twelve-foot intervals were small hollow balls—evidently of aluminum.

They shouted back to the cruiser of their discovery and the launch took Cawthorne, Kilroth and a lieutenant to the barge with orders to secure that wire and take it to the flagship. It was very fine and of some composite metal which neither of the men could designate.

Kilroth, who had closely examined the two ends, exclaimed:

"One end has been broken—torn apart. See this!" and he held up the wire showing the end raveled out, more like a piece of fibrous cloth than like metal. The other end showed distinctly the clean, incisive mark of keen clippers.

But it showed nothing clearly to the engineers and naval officers who were brought over to the flagship from every battleship in the bay. They decided that the aluminum balls were floats to hold that wire—as they found by tests—thirty or forty feet below the surface.

BARON MÜNCHHAUSEN,

as will be noted, has failed to make his appearance this month. Urgent Wireless Telegrams to his chronologist-in-chief, the Hon. I. M. Alier, of Yankton, Mass., disclosed the fact that the venerable old gentleman has contracted a virulent case of *Atmospheris Marsianis*, which sometimes attacks Interplanetarian travelers not acclimatized to the peculiar Martian air. Mr. Alier, however, states that Professor Flitternix, the Baron's companion, advises him that Münchhausen will be back on the job next month. Of course we're sorry, but what can one do?

That night word was sent to the Admiral from a San Diego hospital that a man had been picked up on the south shore totally unconscious; that under medical

accounts of the mysterious current the physicians could not say.

* * * * * * * *

It was three days after that word was received that the man was awake and rational, and frantically eager to make something known to some officer of the navy. Cawthorne was invited to accompany the Admiral and two officers, and although the poor wretch on the cot was emaciated and showed evidences of a fearful struggle, both of mind and body, he slowly told his story. Eliminating his frequent pitiful demonstrations of terror or remorse and his occasional lapses into semi-unconsciousness, he revealed the following:

"My name is Forsythe—Lester Forsythe. Two years ago I invented a device something after the manner of a submarine torpedo, only it wasn't designed for explosives—only to transmit an electric current. I offered it to the United States men at a moderate price after they had made a full examination and tests, but they couldn't make any such contract with me. All they could do was to look into the thing thoroughly and then, if they liked it, recommend Congress to purchase. That was too indefinite to suit me and as the Japs got after me and made big offers I took it up with them. That was before there was the least indication of war.

"I went over to Japan and looked after the development and construction of a lot of those contrivances—we got to calling them 'Shirikari Tentacles.' Say those Japs can teach something about secrecy, all right. There wasn't a workman in those shops who ever got outside, or sent a letter

(*Continued on page* 593.)

The Marvels of Modern Physics

By Rogers D. Rusk

Assistant Instructor in Physics, Ohio Wesleyan University.

THE scientist who would communicate across space with our sister planets, or who would harness the sun directly, or who would do any other of the seeming impossibilities, has always been disbelieved, if not openly ridiculed. However, the change in attitude which has come over the world in a few short centuries is very striking.

Barely 300 years ago Galileo was twice brought before the court for daring to assert his theory of the rotation of the earth and was made to publicly retract his statement. He was heard to murmur afterward, though, "It does move, for all of that."

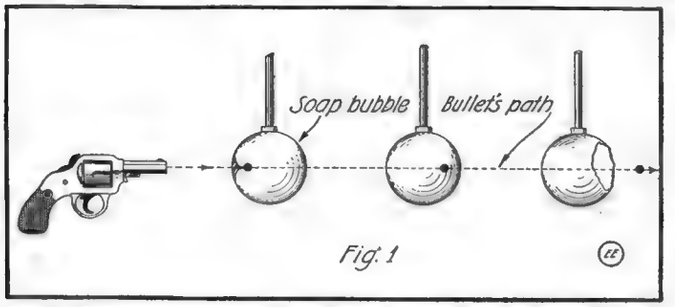


Fig. 1. Diagram Illustrating How a Soap Bubble Fails to Break Until a Bullet Fired Through Same Leaves the Bubble.

A hundred years ago, in our own land, a curious, skeptical crowd of people gathered on the banks of the Hudson River to see what would happen to the "crazy" man who thought he had invented a boat to run by steam. Robert Fulton's steamboat ran, however, "for all of that."

Thus it has always been. Science, besides her own battles, has had to combat the skepticism of the times, and only now is she coming into her rightful honors.

It is hard to measure just how great the accomplishments of the past few years are, for it takes ages to bring out the true worth of a discovery. We can gain an idea of the wonderful advance of the past century, however, by imagining one of the scientists of a hundred years ago brought back for a time to the busy world of to-day. Why, the very commonplace things of our life would amaze him. We can almost see him rubbing his eyes, his brain in a whirl, and at last in despair giving up trying to understand. The remarkable progress of the world would be very vivid to his eyes, while to our own it is hardly noticeable.

For this reason it is the purpose of this article (1) to emphasize some of the greater physical achievements of recent years and (2) to describe in some detail a few of the marvels of experimental physics which to the unscientific mind seem truly like absolute impossibilities.

The majority of recent inventions fall well within the domain of applied physics. Man's victory over the air with heavier-than-air machines and the invention of wireless telegraphy are too well known to need emphasis.

Modern artillery, the seagoing submarine, the phonograph and the automobile, different as they are, are only advanced applications of important basic physical principles.

The field of modern physics has so broadened that it now touches in some way practically every material phase of human endeavor. This rapidly widening field and the constant stream of new discoveries and inventions serve to increase man's control over nature and decrease his physical limitations.

The X-ray has marvelously decreased the limitations of our vision, for we can now "look through" space and objects and even into the human body.

The spectroscope has enabled us to look even to the stars themselves and tell their composition.

Electricity has enabled us to turn night into day and has permitted us to send energy over a thin metallic wire that would create thousands of horsepower.

Modern photography has enabled us to picture the bullet in its flight (see Fig. 1), and even sound waves in the air, while the wireless telephone, like the magic carpet of Bagdad of old, has practically annihilated space. The fairy tales of the ancients are indeed coming true, it seems.

All of the above facts are public property. Nearly every person has heard of them and knows something about them. Few people, however, ever stop to think that these were not the products of a moment's labor or chance discovery. In reality it has taken many years of painstaking labor on the principles involved to make them possible.

The results achieved in the field of pure physical research by those who are pushing forward the boundaries of science are often more marvelous than those results better known to the world.

In later articles the writer may take up the problems which modern physicists are attacking and the results so far achieved, but on account of space limitations this is impossible at present.

Physical research of late years has been most successful in the realms of electricity and radiation. Because these results, in a marvelous manner, have gone a long way toward answering some of the great questions of science, examples of the results obtained will be confined to these fields alone.

Fifty years ago scientists knew that matter could be divided into particles called *molecules*, but to this day the molecule itself has not been seen, for it would take, on an average, about 1,000 molecules, side by side, to make a speck visible with the strongest microscope. However, we know perfectly well that the molecule really exists. Our best proofs come from experimentation with gases and it has lately been proved that the so-called *Brownian movements* are caused by them. Brownian movements have been known for some time as the movements of a globule of liquid (generally oil) suspended in air, or some gases in which there are absolutely no currents. Notwithstanding the fact that the gas may be perfectly stagnant, the globules will dance around at a merry rate due to their bombardment by the flying molecules.

So much for the molecule, but that does not help us very much with reference to the *atom*. Still more impossible to see, how are we to know that it exists? It is a well-known fact that the molecule of any chemical compound can be separated into its constituent parts, and these smallest divisible parts of the elements themselves we term atoms. Practically the same proofs of their physical existence apply to molecules, but the theory that these are the smallest possible divisions of matter is everlastingly exploded by the electron theory. This theory asserts that the atom is composed of a positively charged nuclear mass, about which revolves, at relatively large distances, elemental particles or negative electric charges—the *electrons*.

Truly, here we have an advance into the universe of the minute as remarkable and as wonderful as any journey might be among the bodies of our heavenly universe.

As we have never seen the molecule or atom, it might seem a greater impossibility to prove the existence of the electron.

One of the most brilliant experiments of all science, however, was performed by Prof. Milliken, of Chicago University, when he actually caught and measured the electron. His method was simple enough to admit of explanation here, and all the more valuable on account of its simplicity, as the amount of error in the experiment was thus diminished.

An ordinary atomizer (A) was connected with a reservoir (R), as in Fig. 2, and globules of oil were forced into R from the atomizer by a stream of air passing through glass wool in the tube T, which caught the dust present in the air.

A single droplet of oil was then allowed to drop through a pinhole (P) between two metal plates M and N. As the drop fell it was observed through a magnifying telescope, and an electric field was created between M and N by connecting these plates to a source of current. The speed of the falling droplet of oil could now be increased or diminished, depending on the direction of the field, because the droplet itself carried a slight charge resulting from friction. By adjusting the field the droplet could be made to move at will between the plates M and N. In time the droplet would meet and catch upon its surface an *ion* from the air—an ion, of course, being the carrier of an electric charge.

The sign and size of the ionic charge could be measured by its effect on the speed of the droplet, and if the sign was found negative it was then due to the *electron*, which is always considered negative. Thus did Prof. Milliken capture and measure the electron, but many careful adjustments and methods of precision were necessary, in addition, to bring about the best results. That the size of the electron was determined as one twelve-hundredth that of a hydrogen atom is proof in itself of the brilliancy of the experiment.

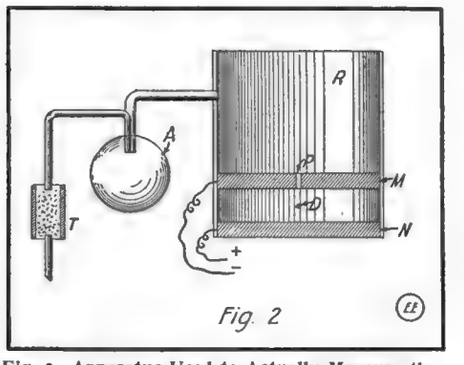
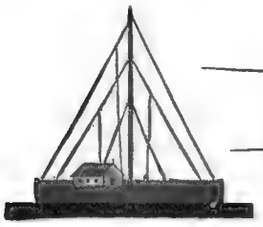


Fig. 2. Apparatus Used to Actually Measure the Electron, by Prof. Milliken.

Rutherford's work on the positive particle is equally famous. In his well-known "Counting Experiment" he determined the charge of a positive particle by counting

(*Continued on page* 594.)



RADIO DEPARTMENT

Latest De Forest Radio Apparatus

DR. DE FOREST and his associates have been recently developing several new radio apparata which we herewith illustrate. Fig. 1 depicts his latest portable wireless telegraphic and telephonic transmitter, as well as receiving outfit. This machine is of the "arc" type and operates on 600 volts direct current. The arc is specially constructed, consisting of two platinum alloy electrodes, which are cooled by means of radiating vanes surrounding them. This self-starting arc is enclosed in the case. The oscillating circuit consists of a variable capacity shown on the left of the case, a variable inductance seen in the center foreground of the cabinet and a hot wire ammeter, shown in the center background, which latter is used for indicating the amount of current transmitted to the antenna. The current in the circuit is varied by the voice through the medium of two specially designed microphones interlocked in parallel with a single mouthpiece connected to both as perceived in the illustration. This set can also be used for telegraphic transmission by substituting the regular telegraph key for the microphone. This is done by merely changing the position of a 2-point switch, which is located on the left of the transmitter bracket base, the key being placed on the cover of the cabinet as depicted in the illustration.

The receiver consists of the standard "audion" detector, variable inductances and capacity and a pair of 'phones. The receiving cabinet is shown on the lower left part of the illustration. This outfit is very compact and portable, which makes it the ideal set for scouting work.

One of the latest audion and ultra-audion receiving sets which is capable of receiving both undamped and damped wave stations is shown in Fig. 4. This consists of an ultra-audion tube, as perceived, with its grid and wing connected properly to an inductance and variable capacity. This is done for the purpose of making the audion oscillate in order to produce "beats," which is essential, of course, for the reception of signals transmitted by stations employing the arc or high frequency alternator. The oscillations produced by the audion are regulated by means of a bridge condenser placed on the lower center part of the cabinet as perceived. An ammeter is used for indicating the amount of current the bulb filament is consuming. The high voltage current in the tube is supplied by a dynamo of from 80 to 125 volt capacity, being regulated by means of a potentiometer which is seen in the extreme upper corner of the illustration. With the potentiometer method of regulating the high voltage a finer adjustment than with batteries can be obtained, as small increments of voltages can be made by merely changing the position of the runner of the regulating instrument. This also eliminates the troublesome batteries, which were, until the present, always used on high-grade audion receiving outfits. A switch for changing from *arc* to *spark* receiving is provided and is seen at the lower right corner of the cabinet. This set is exclusively used by the United States navy on its battleships.

An audion cabinet set for the amateur is also one of the latest products of the De Forest laboratory. One of these is illustrated in Fig. 3. Its cabinet is modeled similarly to the commercial ones. One feature of this type of audion receptor is that it employs a potentiometer for regulating the high voltage battery in the wing circuit, thus eliminating the unnecessary switch contacts. The old method of regulating the high voltage was not very delicate, as increments of four volts could only be added to the circuit, but with this method infinitesimal increments of voltage can be admitted to the wing circuit. The potentiometer is shown on the upper left corner of the audion and consists of a high resistance semi-circular graphite rod, held in place by means of two substantial brass clips. The switch handle contains a circular graphite button sliding over the rod. The only thing that is necessary is to con-

(*Continued on page* 592.)

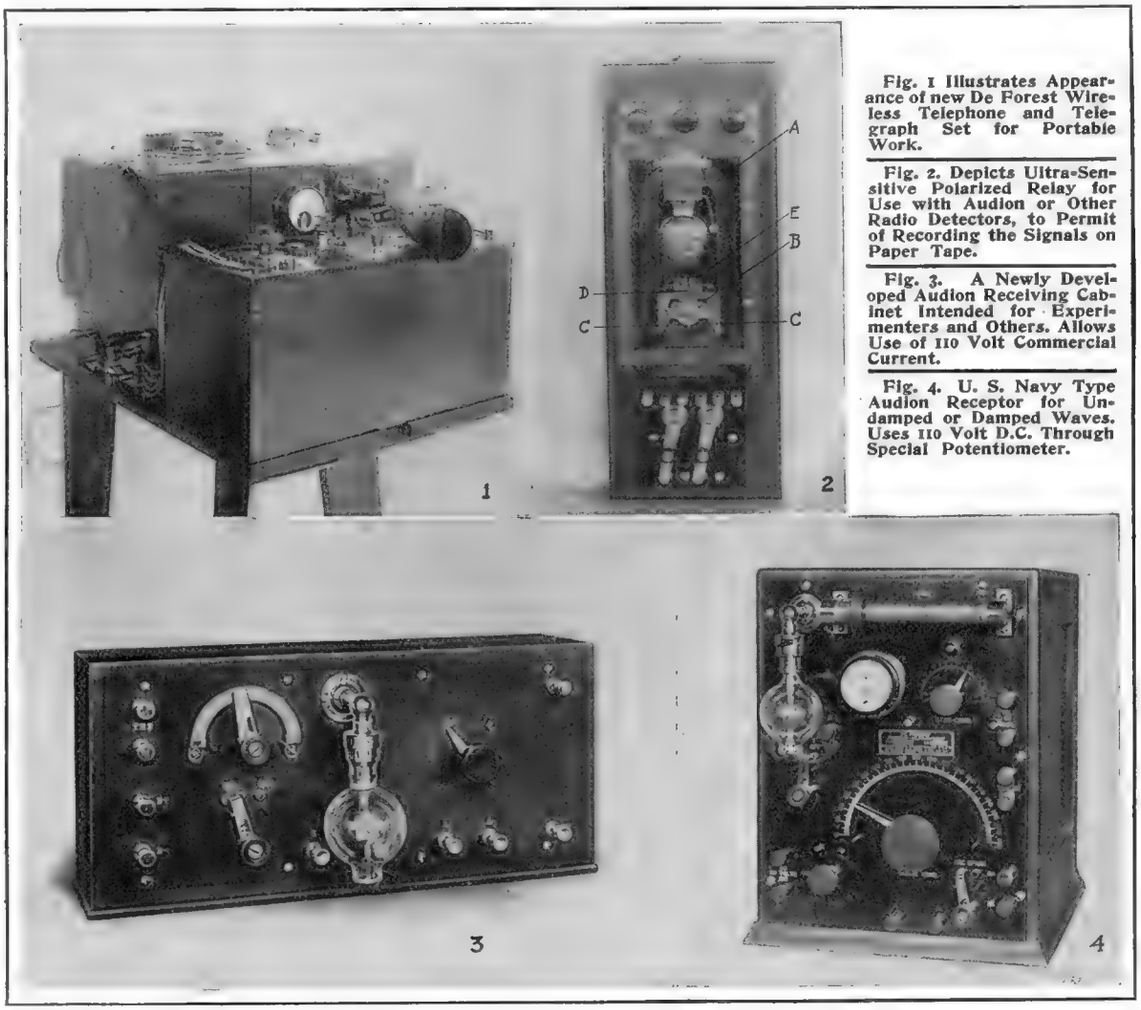


Fig. 1 Illustrates Appearance of new De Forest Wireless Telephone and Telegraph Set for Portable Work.

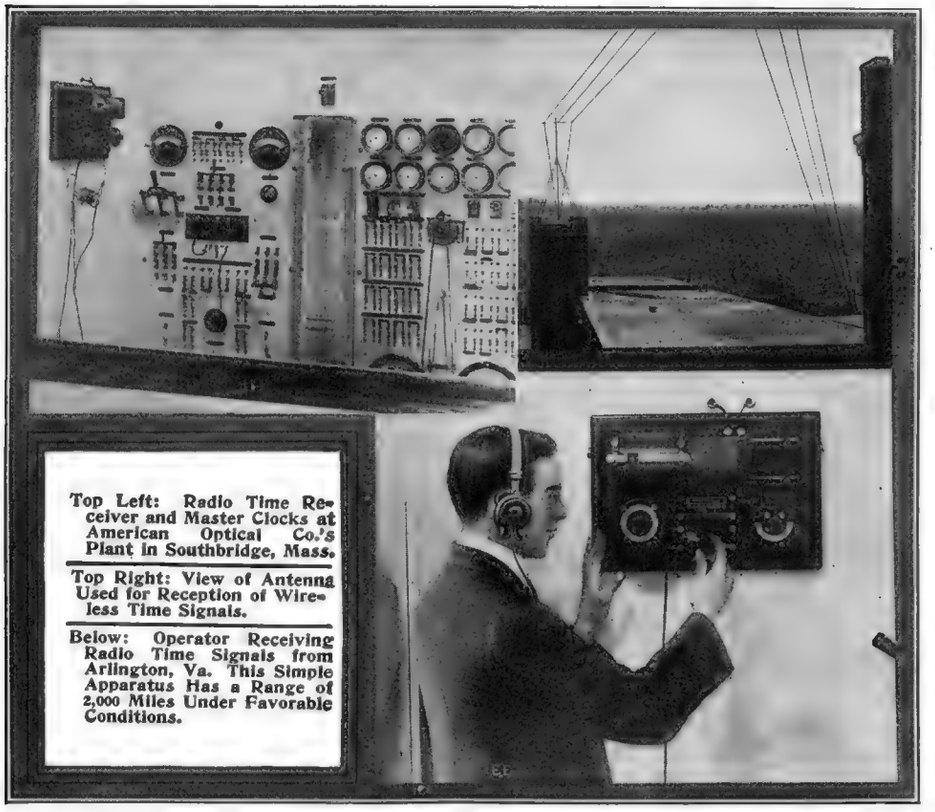
Fig. 2. Depicts Ultra-Sensitive Polarized Relay for Use with Audion or Other Radio Detectors, to Permit of Recording the Signals on Paper Tape.

Fig. 3. A Newly Developed Audion Receiving Cabinet Intended for Experimenters and Others. Allows Use of 110 Volt Commercial Current.

Fig. 4. U. S. Navy Type Audion Receptor for Undamped or Damped Waves. Uses 110 Volt D.C. Through Special Potentiometer.

AMERICAN OPTICAL CO. INSTALLS RADIO TIME SET.

A one-way wireless station, capable only of receiving wireless messages, without any apparatus for sending, has now become popular among industrial concerns, who find the wireless a convenient and accurate means for receiving standard time daily at noon and 10:00 p. m. This economical apparatus, costing but a small amount, consists simply of a receiving panel about 20x 16 inches and a suitable aerial. This receiving apparatus is capable under favorable conditions of receiving from a distance of 2,000 miles. Only a short time is required for the operator to learn the standard wireless time code, so as to be able to receive them properly.



Top Left: Radio Time Receiver and Master Clocks at American Optical Co.'s Plant in Southbridge, Mass.

Top Right: View of Antenna Used for Reception of Wireless Time Signals.

Below: Operator Receiving Radio Time Signals from Arlington, Va. This Simple Apparatus Has a Range of 2,000 Miles Under Favorable Conditions.

The American Optical Company, of Southbridge, Mass., is among the latest to install a radio time receiving apparatus with which it gets standard time from Arlington, Va., daily. The yearly saving and convenience of the wireless message over the telegram has satisfied the officials of this concern that the venture is to be a most satisfactory one. Referring to the group of illustrations the time clocks to be checked by radio twice daily are seen in the upper left view. The antenna is observed at the right, as well as the operator in the act of tuning in the time signals.

GREAT LAKES SHIPS OPEN WAR ON MARCONI RADIO.

Expressing the intention of putting in $20,000 worth of wireless equipment to free itself from the present wireless control of the Great Lakes service, the Goodrich Transit Co. announced it had closed with Kilbourne & Clark, of Seattle, for independent wireless equipment for the steamship "Nevada," now building at Manitowoc, Wis. The new ice crusher went into service in December.

W. H. Thorp, vice-president and general manager of the Goodrich Co., stated recently:

"The Marconi charges have increased approximately 100 per cent. within a recent period. Their charges have to us become practically prohibitive. The public, both traveling and shipping, has come to demand wireless safety equipment, hence a great increase in the volume of wireless business."

NEW WIRELESS STATION AT CAVITE, MANILA.

Three 600-foot steel towers for wireless stations are to be erected in Cavite in the near future. It is believed that towers of that height, if properly equipped, will be able to receive wireless messages across the Pacific Ocean.

NEW FRENCH RADIO INSTRUMENTS.

Several new French radio apparatus are illustrated herewith. Fig. 1 (upper left) shows an improved spark coil for use in portable wireless transmitting, which is operated on storage batteries. This coil is fitted with an extra heavy Morse key mounted on the base of the coil itself, as perceived. Also the vibrator is of special construction, so as to give a constant interrupter speed, and the contact spring carrying the platinum point is placed at right angles to the armature proper, as may be noted. By this method of construction the contact screw with platinum point is located in a vertical position and is thus more readily adjusted than in the common form of spark coil vibrator. This coil is fitted with a new form of spark gap, known as the "mushroom" gap, taking its name from the fact that the sparking electrodes have the form of a mushroom. The coil here shown is capable of transmitting 25 kilometers and measures 35 cm. long, 19 cm. wide and 28 cm. high. It operates on a four-volt storage battery successfully.

Fig. 2 (upper right) shows a very compact wireless receiving set of the Ducretet type, as supplied with a sealed point electrolytic detector, having a removable electrode, which is observed resting on the base at the left. This apparatus is fitted with an automatic cut-out switch for the battery circuit, on which the head 'phones may be hung when the instrument is not in use. This is a feature which many of the French and other foreign makers have incorporated in their sets, but the American manufacturers of similar machines seem loath, for some reason or other, to adopt. The tuning inductances of this receiving set are adjustable by means of two multi-point switches placed on the front of the cabinet, as illustration indicates. A mineral detector is also supplied with the set and may be seen at the right of the base in the illustration. Either detector may be placed into or out of the circuit, as there are provided slotted contact clips which are clamped under the binding post nuts on the top of the cabinet.

In Fig. 3 (bottom) is depicted a complete wireless receiving outfit capable of making a permanent record on a moving paper strip of the received radio signals. This complete apparatus includes a special rotary tuning coil observed at the upper left portion of the illustration. The equipment also includes head 'phones, which may be used in place of the tape recorder when desired. In conjunction with a sealed point electrolytic detector of very fine construction, there is operated an extremely sensitive polarized relay which in turn controls the tape recorder. When desired the signals may be interpreted by means of an electric bell, which is perceived at the right side of the set. Potentiometers and battery are, of course, incorporated in the make-up of the outfit for properly controlling the electrolytic detector .

Top Left: New French Radio Transmitting Coil.
Top Right: Wireless Receptor Fitted with Electrolytic Detector.
Below: Tape Recording Radio Receptor.

The Dubilier Multiple Musical Tone Radio System

RECENT progress in wireless communication has established this branch of science as an indispensable means of transmitting intelligence from one place to another without the use of connecting wires.

A great impetus was given to wireless when the signals transmitted were of a

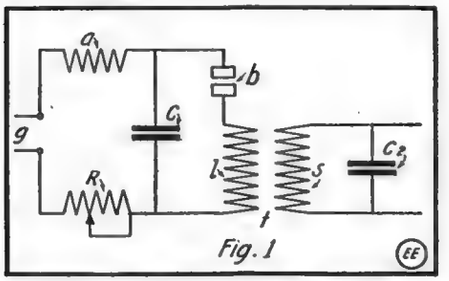


Fig. 1. Circuits of the Dubilier Radio Buzzer Set.

musical tone instead of a mere noise in a telephone receiver. For producing these tones usually an alternator or generator of the rotary type was used, but this becomes a difficult problem, especially for the outputs necessary for portable radio sets. With the elimination of these difficulties in view, but retaining the same desired characteristics, Mr. Dubilier has devised an apparatus by the application of what is known as the Multiple Musical Tone System.

The deserving characteristics of a higher note in the telephone receiver are well known, and is of great importance for the reason that it can easily be distinguished from frequent disturbing noises caused by atmospheric discharges, etc.; it has been proven that these tones carry far better and for longer distance with the minimum amount of energy.

In the present system used the sparks are produced by an alternating dynamo having a corresponding frequency, and as the pitch depends upon the number of cycles of the alternator, a variety of tones is obtained by changing the number of poles or by changing the speed. Both possibilities necessitate and require a complicated construction, combined with low efficiency.

By the system described later on most of the difficulties and defects are avoided; different tones can be produced, one immediately after the other, without any difficulty, and by reason of this a freedom

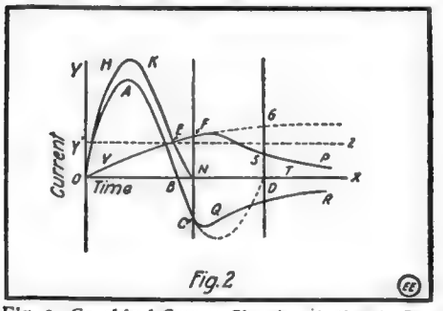


Fig. 2. Graphical Curves Showing Action in Dubilier Radio Transmitter.

from disturbance never attained heretofore is arrived at. Furthermore, for Governmental purposes, a message can be sent in different tones, hence cutting down to a minimum all possibility of interference from the enemy.

If the Morse or any other telegraph alphabet be used, the tone variations can also be employed by using different tones for the dots and dashes, thus preventing messages from being understood by outsiders. Owing to the fact that such a dash does not occupy more time than a dot in transmission, the sending speed of messages is also accelerated.

Due to the peculiar construction of the Dubilier apparatus, the efficiency of same, especially for small equipment, is higher than similar apparatus at present on the market. This is an important feature where a portable field, motor car or aeroplane installation is to be considered, for a maximum amount of power must be obtained with the lightest weight possible and in the smallest space.

In tests made it was found that as much as 50 per cent. of the direct current can be transformed into oscillations, and from this we can safely say it is 100 per cent. higher in efficiency than any other instrument.

In order to obtain the properties and characteristics of the multiple musical tone system, using direct current with an ideal impulse excitation, a connection as shown in Fig. 1 must be used.

In Fig. 1 g is a direct current source, a is an inductive resistance in the form of an electro-magnet for operating the oscillator b. The oscillator circuit c-l-b is tuned to the desired frequency. When resonance is caused to exist between the oscillating circuit and the oscillator there will be a steady and even current produced in the secondary s of the transformer f, which charges the high tension condenser c_2.

On all types of apparatus, using up to 500 watts and a magnetic mechanical oscillator, the electrical frequency of the oscillating circuit will control (to a certain extent) the vibrating frequency of the oscillator, that is to say, it will force the reed to vibrate at a desired frequency so as to keep in step with the circuit.

In Figure 2 the curve OY represents the current amplitude and OX the time axis. For the purpose of illustration, suppose the origin o to correspond with the moment when the condenser c, Fig. 1, is fully charged, and the oscillator b is closed. If the circuit were closed permanently the condenser would discharge through l, as a damped wave, indicated by the curve (Fig. 2) OABCD. Simultaneously the primary current from the source g arises gradually from zero, according to the ordinary exponential law, as shown by the curve OVEFG in Fig. 2.

In all of these types of apparatus, using an electro-magnetically controlled oscillator, a is the magnet coil operating on a spring which controls the (vibrator break) oscillator b. Let OY^1 (Fig. 2) represent the current through the magnets necessary to produce a force equal to the controlling force of the spring. This is also shown at E. The magnetic force of the coil a, however, must be a little more than the force of the spring in order to control it. This is shown at F on the curve. When the primary current through the magnet coil a reaches this point F, the oscillator is opened.

So that there will be no sparking or arcing at the oscillator gap b, there must be no current flowing when it opens. Adding therefore the two current curves OABCD and OVEFG we get OHKEN, the curve of the total current through the oscillator b and the primary l of the transformer. This curve, it is seen, falls at zero when the ordinate NC is equal to the ordinate NF. It is therefore evident that by varying the capacity c, and the resistance R (which determine the curves OVEFG and OABCD respectively), it becomes possible to so adjust the factors that OHKEN reaches zero at the instant of rupture of the circuit, and under these conditions there will be no sparking at the oscillator.

The primary current through the coil a does not cease instantly, but slowly dies away as the condenser c charges up, such as shown by curve FP. This is the charging current for the condenser. We complete the corresponding curve CQR.

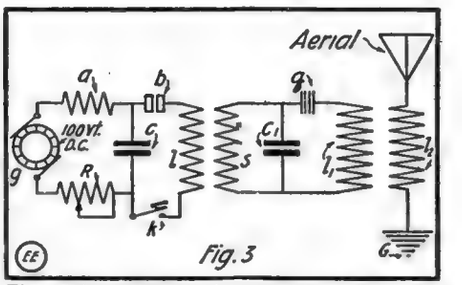


Fig. 3. Arrangement of Musical Tone Radio Set in Complete Transmitting Circuit.

This charging current flows through the coil a and serves to retain the oscillator spring; this keeping the oscillator open until some such point as S is reached, the ordinates OS being slightly less in value than OY_1. Here the oscillator closes again and the operation is repeated, commencing from the point O.

From the above it is obvious that the inductance a, resistance R, and capacity c, play important parts for the smooth operation of these instruments, and this is very well proven by experiment. Further, in order for the note to be a pure one, it is necessary that the second cycle must commence precisely at the point D (Fig. 2), and this can be attained by varying resistance R and the tension on the oscillator reed b.

Furthermore, it is at once seen that if the capacity c is increased, the curve FSP will decrease less rapidly and consequently the effective duration of the current through A, represented by distance ND, will be increased, and therefore the contact will remain open for a longer period, closing at some such point as T. But the

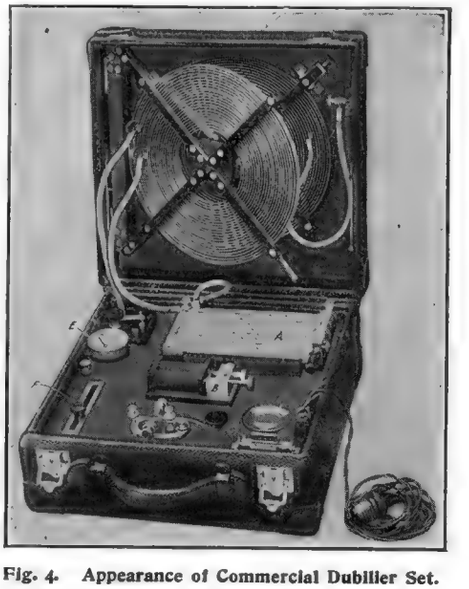


Fig. 4. Appearance of Commercial Dubilier Set.

curve OABCD will also have a greater time period, and will therefore approach zero at some point near T, so that the effective frequency of the oscillator is lowered. Resonance is then obtained by readjusting the primary resistance R, or spring

(*Continued on page* 592.)

The Electric Arc and Its Interesting Applications

By Morton W. Sterns

THE electric arc is such an ordinary sight that one no longer stops to consider it, or any of its numerous interesting applications, but if the subject is followed up there is a field for much experimentation and extremely interesting research.

The object of this article will be, therefore, to open up a new field for research, it is hoped, and one that can be followed up with but little outlay for apparatus.

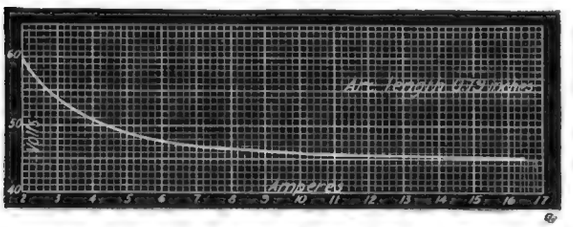


Fig. 1. Characteristic Curve of the "Arc" Showing Decrease of Potential with Increase of Current.

First of all let us consider the arc, what it is, and how produced.

Everyone knows that if two metal or carbon rods are connected to electric supply mains, brought together and then separated, current flows across the gap forming what is known as the electric *arc*. The current flows through the column of hot gaseous vapor, which is termed the *arc stream*, and flows from the positive or anode to the negative or cathode electrode.

The arc stream itself gives off a pale violet light, the useful part of the light coming from the luminous concave end of the anode in the case of the carbon arc.

If, however, the arc takes place between electrodes impregnated with various metallic oxides and salts the arc stream consists of the vaporized salts or oxides and becomes luminous at the high temperature of the arc; therefore in this case the arc stream gives off the greatest portion of the light, while the electrodes remain comparatively cool and do not give off an appreciable amount of light. This is known as the *luminous arc*.

By using various salts or oxides various colors can be obtained with the arc.

The electric arc between carbon or impregnated carbons can be maintained either by alternating or direct current, but it is very difficult to maintain an arc in which one or both electrodes are metal on alternating current, because the massive metal electrode cools so much faster than carbon that the metallic vapor is deposited and cools off each time the current goes through zero, thus preventing the formation of the arc during the next half cycle.

There is a property of the electric arc that is extremely important; that is, when the current through the arc *increases* the voltage across the arc necessary to maintain this current *decreases*.

This property is well shown in the curve of Fig. 1. This shows that it is necessary to always have a resistance connected in series with the arc to limit the current, otherwise due to the inherent characteristic of the arc, as shown by the curve, the current through the arc would increase indefinitely, constituting a short circuit.

This resistance is called the *ballast resistance*. On A. C. a choke coil may be used to limit the current.

One of the most familiar examples of the use of the electric arc is for illuminating purposes, and it is supplied in multitudinous shapes and forms. It is also an important factor in moving picture projection machines.

The arc is used in electric furnaces where very high temperatures are needed, as, for instance, in the manufacture of carborundum, a value of 7,500 degrees Fah. being obtainable.

Another application is in welding. Here the surface to be welded is used as one electrode, while a movable electrode held by the operator is brought into contact with it, forming an arc and thus causing the metal to melt and flow, thus closing up the cracks or fissures.

Another use of the electric arc is in the so-called "speaking arc." If the arc is connected up as shown in Fig. 2 and shunted by a telephone transmitter and a high resistance used to prevent the flow of excessive current from welding the carbon grains in the transmitter, thus rendering it inoperative, and words are spoken into the transmitter, the fluctuation of current in the transmitter circuit will cause a corresponding variation of current in the arc, thereby causing the arc to reproduce speech, music, etc. This property of the arc has been used to some extent as an advertising scheme by having a phonograph call out the wares for sale. Its greatest drawing power is due to the mystification of the passers-by as to where the voice emanates. They never suspect the innocent looking arc light suspended over the entrance.

Another interesting property of the electric arc is its ability to produce high frequency oscillations and the easy means of adjusting the frequency.

There are innumerable forms of such arcs in use and to describe all would be tedious and unnecessary, as they all operate on practically the same principle. We will, therefore, consider the Chaffée arc. This type of arc has the advantage of being easy to construct, is very efficient and requires but little attention.

A simple form of Chaffée or "whistling" arc is made by using a copper beaker filled with water to aid in cooling for one electrode, and a carbon or piece of aluminum for the other electrode. This latter electrode can be fastened to a block of wood and the length of the arc is varied by moving the block to or from the beaker, while both are resting on a flat surface.

If the arc is connected up as shown in Fig. 3 and shunted by a capacity and inductance high frequency oscillations will take place in the circuit containing inductance and capacity.

The reason for this is as follows: When the arc is started current flows, and since a certain voltage exists across the arc the condenser becomes charged. Now if the current fluctuates an infinitesimal amount the voltage across the arc rises or falls, as shown by the curve (Fig. 1,), and the condenser either gathers a higher charge or else discharges across the arc.

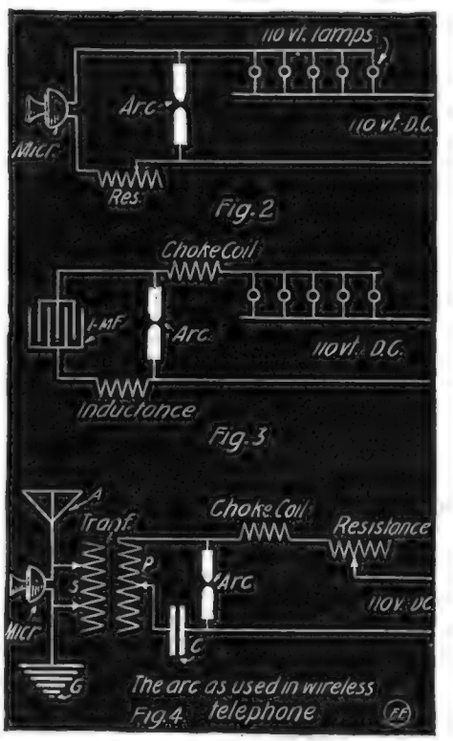
Consider the arc as existing with a certain current flowing and a certain voltage existing across its terminals, the condenser therefore has a certain charge stored in it.

If the current should decrease an infinitesimal amount, due to some cause or other, such as the fluttering of a brush on the dynamo commutator, we see that the voltage across the arc rises, and this causes an increase in the charge of the condenser, since $Q = CE$, where Q is the charge stored in the condenser, C is the capacity of the condenser and E the voltage across its terminals. The current would come back to normal the next instant and since the charge in the condenser is greater than that produced by the voltage now existing across its terminals, the voltage having fallen as shown by the curve, the condenser would discharge across the arc in the form of an oscillatory discharge of high frequency. Hence there would exist in the circuit containing an inductance and capacity high frequency oscillations, while in the arc circuit we would have a pulsating direct current. An inductance or choke coil is connected in the supply to prevent the high frequency currents from reaching the D. C. generator.

For ordinary experimental use the type of arc described above can be used and shunted by a 1 M. F. condenser of the ordinary telephone type and an inductance consisting of a coil of No. 20 B. & S. copper wire wound on a form 3 inches in diameter and 12 inches long, tapped about every 25 turns, or else it may be fitted with a slider, as on the ordinary tuning coil, which, in fact, can be used to good advantage.

Now by varying the inductance the frequency can be varied, and this will be shown by the tone of the whistle produced by the arc.

All tones of the scale can be produced, and the frequency can be increased to above



Hook-Ups for Utilization of "Arc" in Producing Speech, Music, Etc.

audibility. At this point it can be used in wireless telephony.

To use the Chaffée or "whistling arc" for wireless telephony it would be well to build a more substantial arc, using a copper tube with water circulating in it for one electrode and an aluminum bar for the other electrode. It will help somewhat to have the arc take place in an atmosphere of ordinary illuminating gas or hydrogen gas.

(*Continued on page* 595.)

DETERMINING THE LAG BETWEEN ARLINGTON AND KEY WEST RADIO TIME SIGNALS.

Although not generally known, there is an appreciable and measurable lag in the time signals sent out by the powerful Government stations at Arlington, Va., and at Key West, Fla. Special chronographic apparatus, with suitable recording attachments, have been installed at the Elgin National Watch Co.'s plant at Elgin, Ill. Frank D. Urie reports on the tests made at this point on the radio time signal lag in the Bulletin of the Astronomical Society. The distance between Arlington and Elgin is 700 miles and between the latter point and Key West 1,250 miles.

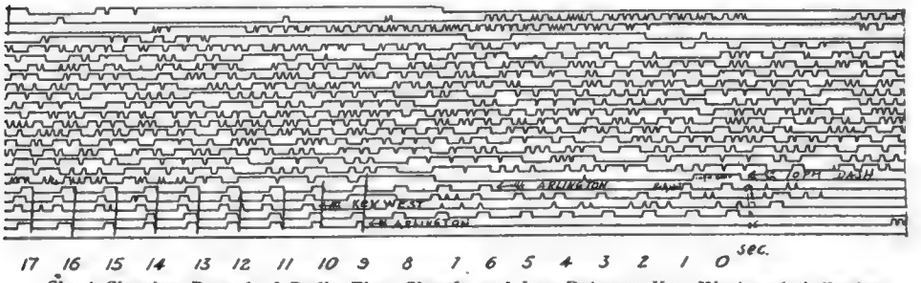


Chart Showing Record of Radio Time Signals and Lag Between Key West and Arlington.

A T-shaped aerial was employed at the Elgin plant, consisting of four wires, each 280 feet long and 150 feet high. To this antenna was connected a Telefunken receiving set, of the inductively coupled transformer pattern, using a galena detector.

The detector current was lead to a series of amplifiers, which intensified the Arlington signals sufficiently to operate a very sensitive relay, the back contact points of which controlled a five-ohm pony relay, and this in turn controlled the chronograph circuit. The individual apparatus was carefully checked up and special means for compensating the differences in the operation of the instruments were devised by Mr. Urie.

The transmitting clock at the United States Naval Observatory sends the time signals by wire to Arlington and also to Key West. At each of these radio stations the wire signals are automatically converted into radio signals. Owing to the 900 miles of telegraph wire between Washington and Key West, involving several make-circuit relays, the Key West radio time signals lag perceptibly on the Arlington radio time signals.

While developing the radio recording device Mr. Urie found that it was possible to record at Elgin both the Arlington and the Key West radio time signals on the same chronograph sheet. The determination of the time lag between Arlington and Key West was undertaken in January, 1915, at the request of Captain Hoogewerff, superintendent of the United States Naval Observatory. During February the investigation was interrupted by the destruction of the Elgin (Ill.) antenna in a sleet and wind storm. The antenna was replaced as soon as possible and the investigation was continued through March.

The plan was to record the first minute of Arlington, then tune to Key West and record the second, third and fourth minutes; then tune again to Arlington and record the fifth minute.

The accompanying reproduction of part of the chronograph sheet of Jan. 29, 1915, shows how this was done. After the record was obtained vertical lines were drawn between the same seconds of the first and fifth minutes of Arlington. The lag of Key West could then be directly measured for every individual second. This method has the advantage that it eliminates entirely any errors in the teeth of the contact wheel of the transmitting clock, as the lag is always measured from the records of the same individual second.

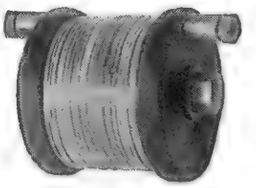
The results of the lag determination are:

	No. of comparisons.	Lag of Key West.
Jan. 23, 1915.....	29	0.277 sec.
" 26, 1915.....	16	0.250 "
" 29, 1915.....	77	0.267 "
Mar. 8, 1915.....	22	0.240 "
" 10, 1915.....	48	0.120 "

Apparently there was some unusual lag on March 10 in the Arlington signals. This date has, therefore, been rejected in taking the average result of the determination, which gives the lag between Arlington and Key West as + 0.258 sec.

NEW QUENCHED SPARK GAP FOR AMATEURS.

A unique quenched spark gap has recently been put on the market which undoubtedly will find favor among radio experimenters. As is well known, the quenched spark gap is one of the very best available for this class of work and it produces a pure wave, as required by the United States radio law now in effect, and besides has several other valuable inherent characteristics.



New Quenched Spark Gap for Amateur Stations.

The quenched gap in question is shown in the illustration herewith and measures 2¾ inches long by 1⅞ inches in diameter, having 24 gaps of standard length, viz.: .01 inch each, and thus the gap will handle about 24,000 volts, such as from a spark coil, etc. A less number of gaps than the total number may be readily used in the circuit by leaving one wire connected to the end terminal, and the second connection from the condenser circuit is secured around one of the brass plates making up the gap. For high power sets using transformers several of these gaps are connected in series-parallel, to accommodate properly the amount of energy passing through the circuit.

This gap, as may be observed, is composed of two fiber end discs carrying the binding post terminals and each of these is clamped to the end gap plates. Between every two metal plates there is inserted a mica washer of the proper thickness and these are so perforated as to provide a true vacuum gap between the spark plates. This, of course, is absolutely necessary if the quenching is to be performed in the proper manner and as necessitated in the action of this particular piece of apparatus. There are some gaps on the market that are termed quenched gaps by their sponsors, but in reality they are no such thing, as the sparking electrodes are placed in the open air. This gap is readily assembled and disassembled by means of a strong center bolt and nut which clamps the whole together firmly in one operation. It is also well ventilated inside and outside, as there are several holes drilled through the fiber end discs, thus providing double ventilation.

SAYVILLE WIRELESS WORKING AGAIN.

Wireless communication via Sayville, N. Y., is restored and messages can again be accepted to go by wireless via Sayville to Germany, Austria-Hungary, Turkey and non-belligerent countries.

A COMPACT RADIO DETECTOR CABINET.

In the new detector cabinet here illustrated there is embodied in a single unit every element necessary to rectify into audibility any wireless signals you care to hear.

This set consists of a highly finished mahogany case in which is located a supersensitive Crystaloi detector cylinder, the periphery of which protrudes through the top, making it accessible for rotating to secure finest adjustment. A cohering inductance especially calculated and calibrated to the supersensitive detector is included, as well as a fixed condenser with the exact capacity for this particular instrument. A specially wound buzzer, the frequency of which is controlled by a knurled screw head mounted on the front of the case to produce a note that is best suited to assist in cohering the alloy in the cylinder is mounted within the neat cabinet, also two of the highest grade dry batteries to operate the buzzer. A buzzer control button protrudes through the top of the case for accessibility.

This case is equipped with four binding posts, two of which are for the 'phones and two for the tuner leads and is provided with anti-shock feet which renders it immune from mechanical shocks and jars.

The specially wound buzzer has an adjustable frequency range of 1,000 to 2,000 vibrations per second.

With this carefully designed and calibrated instrument you have but to set it on the table, connect your 'phones and leads from your tuning coil and you are permanently and thoroughly equipped to engage in the most serious wireless work of the present day. Of course, variable condensers can be added if desired. The fact that every part of this apparatus is designed, built and proportioned to work with each other makes it a superior piece of wireless mechanism.

Neat Radio Detector and Test Buzzer Set.

Manager, H. Gernsback

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Subsidiary Radio Clubs.

SINCE the formation of the RADIO LEAGUE OF AMERICA two months ago we have been asked by a great many local Wireless Clubs as well as by local Wireless Associations if these organizations could become directly connected with the LEAGUE in some form or other.

As the LEAGUE champions the cause of all Radio Amateurs, without exception, it is highly desirable that every radio club should become directly affiliated with the LEAGUE. The RADIO LEAGUE OF AMERICA being a central body, organized to bring all the Amateurs together, to ward off hostile legislation and to serve the United States during peace as well as during war, it is in an excellent position not only to benefit every Amateur, but every local club as well.

It is highly probable that the future will see new attempts to curb the Amateur. Hostile bills will certainly be introduced in Congress, and it is one of the first duties of the RADIO LEAGUE OF AMERICA to safeguard the Amateur's rights. No other body is in such an excellent position to do this as the LEAGUE. No other body can obtain facts quicker or better than the LEAGUE. Therefore, if all the local clubs and associations are directly affiliated with the LEAGUE, only good can come of it.

Of course this is not the only reason. Suppose that every club and all its members were directly affiliated with the LEAGUE. Also suppose that, for obvious reasons, the Government should wish to mobilize all the Amateurs, be it for a test maneuvre or for actual eventualities. Would not the LEAGUE be in a paramount position to quickly convey such intelligence to the affiliated clubs and its members? Naturally this can only be effected in a satisfactory manner if the names of the clubs are on file and if its members are enrolled in the LEAGUE.

In order that a club or association can become affiliated directly and permanently, the following is required:

The president as well as two officers of the club must be members of the RADIO LEAGUE OF AMERICA. Upon application to the manager of the LEAGUE, a special certificate will be made out to the club and this certificate must be constantly displayed at the club's headquarters.

A special form of application blank as well as detailed instructions will be furnished by the manager of the LEAGUE upon request to the secretaries of local clubs and associations.

It is, of course, understood that there are no fees, or membership dues to be paid to the LEAGUE either by the club, by its officers or by its members. The manager hopes to hear from every club and every association in due time.

Formation of New Clubs.

We stated in our December issue how exceedingly simple it is for Amateurs to form new clubs. As the RADIO LEAGUE OF AMERICA now has above 5,000 members scattered all over the United States, it becomes an easy matter to bring Amateurs together.

As an example, suppose you live in Springfield, Ohio. (This city was taken at random.) As all records of members' names of the LEAGUE are filed geographically, the writer is informed that there are 19 members enrolled from Springfield, Ohio. Offhand we do not know if there exists a Radio Club in Springfield, but let us assume there is none as yet. Also let us assume that you are a live and wide-awake member living in Springfield. By sending a stamped return envelope to the manager of the LEAGUE and stating your desire, the LEAGUE will furnish you, free of charge, with the names of 19 members. You can thus easily get into touch with them, and a new club may be formed in this manner with but little trouble.

In our March number will be found one of the most elaborate articles ever printed on how to form and manage a Radio Club. It will be exceedingly well illustrated with pictures of existing clubs, their radio equipment, etc., etc.

In that issue will also be found a complete Directory of Radio Clubs in the United States. Do not miss this issue.

To Members of the R. L. O. A.

Those members not having received their membership blanks till recently will kindly excuse the delay. The first 1,200 blanks were promptly mailed in the middle of December. This amount represented the entire supply delivered, as our lithographer had an unfortunate accident in breaking the stone from which the certificates are printed. This naturally caused an unavoidable delay, and for that reason the balance of the certificates could not be mailed before the middle of January. We now have a large supply at hand, and if by chance anyone should not have received his certificate the manager will be glad to look into the complaint at once.

To Radio Clubs.

As announced above, the March issue will contain a complete Directory of all Radio Clubs in the United States. We will publish the names of all clubs about which announcements have been published in *The Electrical Experimenter*, as well as in other journals in the past. In order to make the directory complete, those clubs not having been announced in the wireless and kindred journals will kindly communicate with the manager of the RADIO LEAGUE at once. The benefit that the clubs and associations will derive by being listed in the Directory is obvious. *The Electrical Experimenter* now prints over 53,000 copies monthly and is read by over 150,000 wireless enthusiasts. It is by far the most widely distributed Wireless Organ, barring none, in the world.

* * *

Complete information of the RADIO LEAGUE OF AMERICA, its purpose and its plans will be mailed free for the asking. Every American Wireless Amateur is eligible as a member. Beautiful membership certificate free to members. The LEAGUE is not a money-making organization. There are no fees, no membership dues, etc. WRITE *TO-DAY*.

BROOKLYN, N. Y., YOUTH MAKES VALUABLE RADIO INVENTION.

Government experts recently concluded their tests as to the practicability of the under water telegraph device for submarines, invented by Elmer Matthew Rave, of Brooklyn, N. Y., and reported to Secretary of the Navy Daniels that the device passed every test. The inventor, 20 years old, offered the invention to the Government for a sum total of $275,000.

Young Rave has received many offers from foreign governments for the mechanism which is designed for the protection of sailors in submarines. The most flattering was made, it is understood, through D. Fedotoff, naval attache of the Russian Imperial Embassy, but Rave decided to offer it to the United States before considering any offer from foreign nations.

The tests covered a period of some weeks and were very exhaustive. The Government officials were given strict instructions to go to the bottom of the matter and find out if the invention was at all feasible and practicable. Their report is exceedingly gratifying to Mr. Rave.

This invention, which will be controlled by wireless, will take the place of the present submarine sound signaling bell system, now in universal use in submarines. It will enable a crew of a submarine, while submerged, to communicate by wireless with other ships or stations. In the case of an accident under water it will admit of a call for help.

Rave is a graduate of Commercial High School, Brooklyn, and has been working on the invention since the disaster to the submarine F-4 in Honolulu Harbor.

9,000-MILE RADIO A NEW RECORD.

What is stated to be a record in radio transmission was established on Nov. 29 last, when an operator for the Federal Wireless Telegraph Co. at Honolulu picked up wireless messages being transmitted from Nauen, Prussia, to Tuckerton, N. J., approximately 9,000 miles away.

The German operator was sending war despatches, and the dots and dashes registered so clearly in the Honolulu radio station that the eavesdropper had no difficulty in copying the report.

TO ISSUE NATIONAL EDITION OF LIST OF RADIO STATIONS.

The United States Bureau of Navigation, Department of Commerce, has in the hands of the Public Printer, its annual edition of the "List of radio stations of the United States," containing a list of 5,073 stations. The table here given shows the number of land, ship, special land, and amateur stations in this publication, as compared with that of 1914:

Classes of stations.	1914.	1915.	Increase.
Government and commercial land stations	189	224	35
Do. ship stations	895	895	0
Special land stations.....	54	118	64
General and restricted amateur stations 2,796	3,836		1,040
Total 3,934	5.073		1,139

The appendix to this list contains several articles of interest to radio operators. The book, which has been available since Nov. 1, may be procured from the Superintendent of Documents, Washington, D. C., at 15 cents per copy. Copies of the "Radio-communication laws and regulations" may be procured from the Superintendent of Documents at 15 cents per copy.

THE CONSTRUCTOR

Construction of a Collin's Radiophone Arc

By H. Winfield Secor

WIRELESS telephony is possibly the most interesting branch of science with which the radio and electrical experimenter comes in contact. Herewith directions are given for constructing a Collin's Oscillating Arc, adapted for generating high-frequency currents well suited to experimental radiophonic requirements. Such an arc generator as here described can be made up quite cheaply, and, moreover, is of such design as to permit of a wide range of interesting experiments, such as enclosing the arc proper in a gas-tight chamber in which hydrogen, alcohol or illuminating gas can be used; also, the arc has been found to operate very satisfactorily in an envelope of steam.*

The constructional details of a Collin's Oscillating Arc generator are given in the illustration herewith presented. This arc, it may be said at the start, utilizes graphite discs, which rotate at fairly high speed, and the arc proper is sustained between their rapidly moving peripheries. Graphite has been found, after extensive tests at the United States Bureau of Standards laboratories, to be absolutely the best material for such an arc, especially when it is to be used for considerable periods, and to produce oscillations steadily without frequent readjustment of the apparatus.

The dimensions of the apparatus here suggested may be deviated from to some extent, without any detrimental effect, so long as the principal features are incorporated in the make-up of the whole. Referring to the working drawings (Figs. 1 and 2), A is a slate or asbestos composition switchboard about ½ inch thick. B is a brass strip making contact with the brass or phosphor bronze bearings N, in which the spindles carrying the rotating graphite discs revolve. A fiber or hard rubber block R is indicated, which has a width of 1½ inches. This carries the bearing N, also disc K, pinions P, etc., and may be moved up and down when adjusted by the screw S_1 at the top of the arc generator. A fiber or hard rubber block is denoted at D also, being about 1½ inches wide. Wrought iron or brass supports E are made up from ¼x½-inch stock or slightly heavier, if available.

The magnetic blast for this arc comprises wrought iron magnet cores F fitted to a wrought iron yoke G. Insulation on the varius parts of the apparatus, such as around the pinions, etc., is indicated by I. This is to prevent electrical connection between the pinion and shaft L, etc. Long machine screws, carrying large-sized knurled heads, are observed at J, the ends of same being ground or filed to a point, with about a 60-degree taper. These points face each other and are so arranged as to project between the revolving graphite discs.

At K is seen the graphite arc discs, made up from ¼-inch or ⅜-inch stock, with a diameter of about 2 inches. Carbon may be used, but it will not give the results obtainable with graphite. These discs are rotated by the shaft at the rear of the apparatus, which is driven by belt from a small fan motor at the rate of 400 r. p. m. or more. The arc length is varied by means of the adjustment screw S_1 and the charteristics of the arc may be changed also by adjusting the magnetic blow-out poles J.

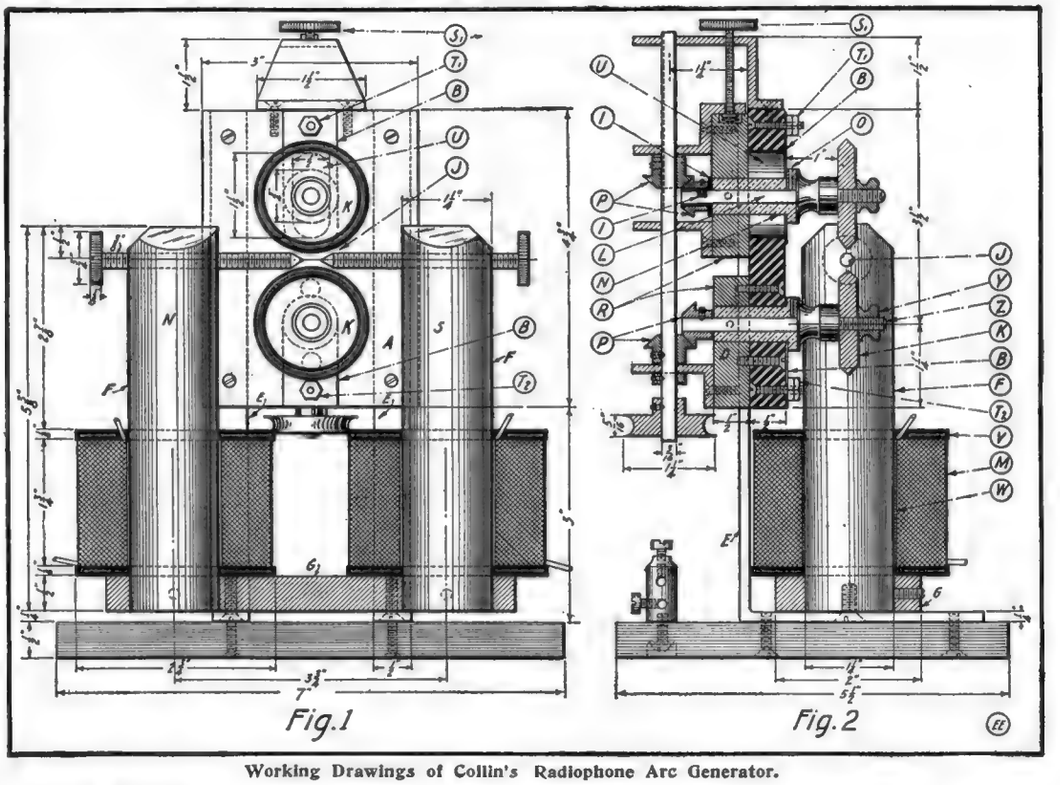
At the rear of the instrument there is a vertical iron or brass shaft L. This may be about 3/16 inch in diameter. It carries the small brass pinions P, the upper one of which is provided with a key, which slides in a key-way cut into the shaft as indicated in Fig. 2. This permits the upper electrode block R, together with the upper pinion P, to slide up and down the shaft while the latter is rotating. This arrangement will permit of adjusting the arc length while it is in operation, as becomes evident. All of the gear pinions P are of the same pitch (say about 32 pitch) and have 16 teeth per pinion.

The magnetic blow-out coils M each contain nine layers of No. 12 B. & S. double cotton-covered magnet wire. The two coils are connected in series to give north and south poles, respectively, at the adjustable electrode terminals J. The iron cores on which the magnet coils are wound are first insulated by winding three layers of Empire cloth around them.

The brass or phosphor bronze bearings N are provided with oil holes O. The upper bearing is movable up or down in a slot cut in the board A. The terminals of the arc proper are indicated at T_1 and T_2, either one being used for the positive electrode, according to the best result with respect to the polarity of the magnetic field applied.

It may be well to state that this arc should never be started—i. e., the current should not be applied to the rotating graphite electrodes—until they have been speeded up to a high velocity. Greatly enhanced results will be obtained with this or any arc generator if the arc proper is burned in an atmosphere of hydrogen or other vapor, and some vital points in this direction are cited later on in this article.

The diagram of connections for this arc generator intended for radio-telephony is observed at Fig. 3. Referring to this more in detail, CK are choke coils comprising soft iron wire cores 8 inches long by 1 inch in diameter. These are covered with three layers of Empire cloth, and over this three layers of No. 12 B. & S. insulated magnet



Working Drawings of Collin's Radiophone Arc Generator.

* See Reprint No. 60, Bureau of Standards Bulletin, "The Production of High Frequency Oscillations from the Electric Arc," by Dr. L. W. Austin.

wire is placed, taps being taken from each layer so as to allow for adjusting the choking effect. This arc may be used on 110 to 220 volts direct current, or even a higher voltage providing a sufficient resistance R is utilized to control the current properly.

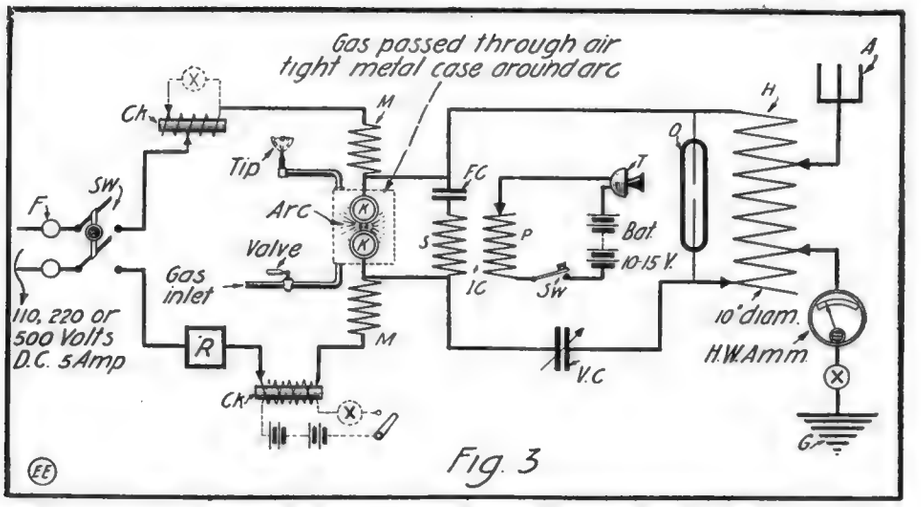


Diagram of Connections for Wireless Telephone Arc.

VC is a rotary condenser of standard pattern, filled with *castor oil*, which has the effect of increasing the insulation of same and also of raising the capacity to about five times the original value, with air dielectric. The helix shown may comprise 30 turns of No. 6 brass or copper wire wound on a wooden frame 16 inches long and 10 inches in diameter, spacing the turns one-half inch apart. Suitable clips are used to permit the use of as much of the helix inductance as required. An instrument for indicating the maximum oscillations produced in the shunt arc circuit and known as the "oscilloscope," is shown at O. This may be purchased from any electro-therapeutical concern at small cost, but this is not necessary for general work.

The optional locations of the microphone transmitter T are indicated at points X X, etc. A common location for the microphone or transmitter is in series with the ground lead, as is also that for the hot wire ammeter. A method employed more or less for superimposing the voice currents on the arc circuit, utilizes an induction coil I C, which may be a ¼-inch spark coil. If this is not available a suitable induction coil may be made up with the following dimensions: soft iron wire core 5½ inches long and ½ inch in diameter, insulated with two layers of paper. A primary winding is wound over this, consisting of two layers of No. 20 B. & S.—D. C. C. magnet wire. Wound over the primary are six layers of Empire cloth and then the secondary coil, consisting of four ounces of No. 36 B. & S. enameled magnet wire is wound in place. This may be put on with paper between each layer. A fixed condenser, F C in the microphone superimposing circuit, may be made of three or four pieces of Empire cloth, each 8x10 inches — 1/100 inch in thickness, or 10 mils. These sheets are coated on both sides with slightly smaller tin-foil and the whole is then laid together with connections made to alternate tin-foil leaves, in the usual manner.

If illuminating gas is used in the gas-tight chamber placed around the arc, a good scheme is to provide a gas tip leading out of the chamber. The tip is lighted, as here indicated, for this is conducive to the best circulation of the gas through the chamber.

This set may be used on any size antenna, but, of course, the longer and higher the aerial wires, the more pronounced the results will be as regards the talking range. Any wireless receiving set will pick up radiophonic speech and this arc generator is capable of talking 20 to 25 miles when properly operated with a gas enveloped arc.

In case it is desired to superimpose the voice current on one of the choke coils C K, a secondary winding may be wound over the outside of the choke coil winding proper, as indicated; X being microphone and a battery, of course, being connected in series with the coil and the transmitter. This secondary coil may consist of three layers of No. 18 B. & S. insulated magnet wire and several layers of Empire cloth, or waxed paper should be interposed between the two windings.

Dr. L. W. Austin has ascertained that for a simple arc generator, graphite electrodes are better than most any other material, especially where steady oscillations are required for making quantitative observations and tests. The various circuit quantities employed in one of Dr. Austin's researches were as follows: Primary circuit of arc: Electrodes—graphite, flat ends, diameter 12 mm.; resistance in series with arc about 50 ohms; arc current 4 amperes; potential difference across arc 26 volts and across open circuit 242 volts; arc length about 0.3 mm.; inductance in shunt circuit .009 milli-henry; capacity 0.4 m.f.; alternating current in shunt 4.0 amperes. Secondary (inductively coupled) test circuit values: Inductance 0.168 milli-henry; capacity —variable; resistance circuit 7 ohms; current 0.1 to 0.2 amperes. With these conditions it was found that the arc would easily produce oscillations steadily for periods of one-half hour or longer. When the frequency was measured by the secondary resonance circuit, it was found that there were present well-marked maxima corresponding to frequencies of 205,000, 580,000 and 910,000 cycles per second. The lowest frequency appeared to carry the largest part of the energy, while the highest was the weakest. The frequency calculated from the inductance and capacity of the primary circuit; *i.e.*, shunt oscillatory circuit of the arc was 260,000 cycles per second. He was unable to find any other frequencies present, but the possibility of such seemed fairly certain.

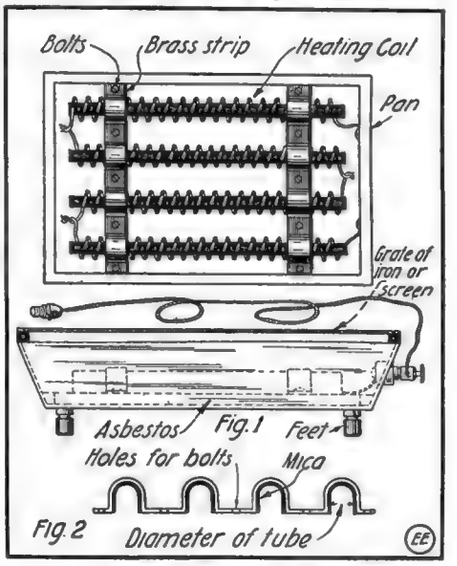
Burning the arc in hydrogen after Poulsen's method, Dr. Austin found, caused the more rapid production of oscillations, also permitting of a longer arc length or up to 0.8 mm. in the case of graphite at 240 volts line potential. Marked indeed was the increase of the amount of energy which could be drawn from the oscillating circuit. With the graphite arc in air only about 6 to 8 watts were available, but by utilizing a hydrogen envelope, over 100 watts could be drawn; in one experiment bringing a 110-volt—32 c.p. lamp to full brightness.

It seems that the effect of the hydrogen gas on the arc is partly due to the high heat conductivity of the gas, which thus helps to cool the electrodes. Poulsen claims, in addition to the cooling effect, that there is a marked influence on the electrical conductivity of the arc, which he considers of great importance. With the arc in steam all the benefits derived from hydrogen were readily duplicated. Oscillations of great power were also observed when the arc was formed under water, where the steam was produced by the heat of the discharge. Satisfactory results have been obtained with the arc burned in compressed air also. The arc, although ordinarily unstable, has thus been found to be a most satisfactory source of undamped waves for wireless purposes. Moreover, it is a device available to most all radio experimenters, and they will indeed find their time well spent in trying it out.

HOW TO MAKE AN ELECTRIC TOASTER.

The most palatable toast is said to be that made upon an electric toaster. The toaster herewith described can be constructed by anyone.

Procure a common bread pan or other metallic dish. Next obtain a piece of asbestos board ½ inch thick and just a trifle smaller than the inside of the pan. Place the asbestos inside of the pan and drill 10 holes in the bottom for tube clamps, as shown. Now obtain four porcelain tubes and upon each one wind about 30 turns of No. 24 German silver wire. Two strips of brass made, as shown in Fig. 2, are used to clamp the four resistance coils to the pan by means of ⅛-inch stove bolts and nuts. The coils are connected in series and the two end terminals are brought to two insulated binding posts as shown. Care should be taken to see that the binding posts do not touch any part of the pan, using mica or fibre washers around their securing screws. A small grate or screen of iron is made for the top of the toaster.



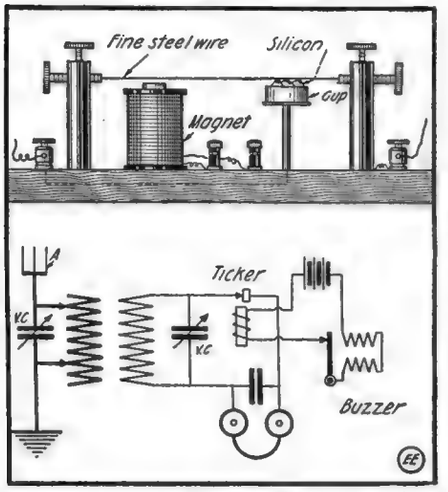
Details of Electric Toaster.

The wire should get red hot in a minute or so and by using less turns of the resistance wire in circuit the heating effect will be increased. Four porcelain knobs should be placed at the corners to raise the pan above the table. The drawing is self-explanatory. This toaster is intended for use on 110 volt circuits.

A SILICON "TIKKER."

Many radio amateurs, especially those living in the Eastern States, cannot catch Arc signals. The tikker, of which I give a drawing, is just the thing. A buzzer must be put in the circuit of the magnet to make the necessary interruptions. Build one, boys, and see what you have been missing!

Contributed by
LEIGHTON JOHNSTON.

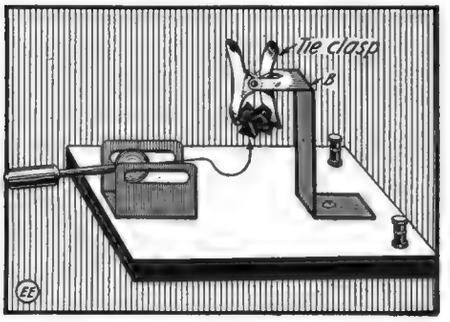


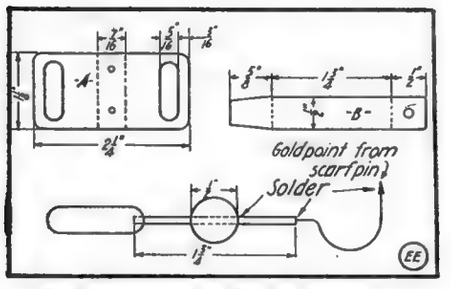
Tikker Comprising Steel Wire Vibrating Against Silicon.

A NOVEL DETECTOR.

Following is a description of a detector I made with which you can touch every part of the crystal by simply moving one knob.

First get some ⅛-inch springy brass and cut to the shape shown at A. The openings can be made by first drilling holes and then filing. Then bend on dotted lines. Now get a brass ball ½-inch in diameter and drill a hole through it to admit the brass rod which has a thread on one end to take the knob. The ball and a piece of fine brass wire are soldered





Ball Adjustment for Mineral Detectors.

on the rod. I find the point from a gold scarf pin to be very sensitive as a "cat-whisker" and it does not tarnish. The standard, B, is made from heavy brass and the tie clasp is soldered on to hold the crystal. The inverted position of the crystal keeps the dust from settling on it and thus causing it to lose its sensitiveness. The base can be made from hard rubber or hard wood. Parts A should be tight enough to keep the ball in place. The knob can be moved back and forth or in any direction.

Contributed by G. F. EXNER.

MONEY-SAVING HINTS FOR THE EXPERIMENTER.

Electrical apparatus of all kinds involves an outlay of money which soon runs into quite appreciable amounts—at least to the junior mechanics. A few suggestions along the line of procuring some necessary materials may be of help in cutting down expenses to a minimum.

Fine resistance wire, for instance, is costly when bought at the supply houses, but a very cheap substitute that will do the work well, providing the working temperature is not too high, is the wire used in making galvanized window screens. This can be unraveled easily from a piece of screen, and the wire is continuous. I have made several small rheostats from this material and they all work well.

The brass lining of an old Ford automobile wind shield makes good slider rods for tuning coils, potentiometers, etc.

It is a good plan to save all old battery bolts, binding posts, connectors, brass ribbon, wire, etc., as they will prove useful at one time or another.

The rubber casings of discarded storage batteries may be employed to advantage in several ways. The sides may be cut out with a hack-saw and scraped and polished. These make good detector bases. If the case is unbroken it makes a good container for a small condenser which is to be immersed in oil.

Cheap sending condensers for spark coils up to one inch capacity can be made from small test tubes. The six-inch size is preferable. They should be coated inside and out to within one-half inch from the end with tinfoil. A tinfoil lead may be used as a connector to the inner coating by bringing it out through a hole in a paraffined cork plugged in the opening.

Supports for the terminals of a small spark gap can be made from the lightning arresters on old-fashioned telephones. These consist of three large binding posts, with a half-inch hole drilled transversely through each for holding the carbon rods. Zinc may be used in place of the carbon rods, and a series gap is the result.

An efficient ground connection can be made from a 1½-inch galvanized iron pipe which has been burst by freezing. A cap should be placed on one end and the pipe driven into moist ground to a depth of at least six feet. Strong salt water should be poured into the open end of the pipe until the earth near the pipe is thoroughly moist. The ground wire may then be soldered to the top of the pipe or secured by means of a clamp. Water must be poured down the pipe frequently for best results.

Contributed by FRANK SAHLMAN.

1,000 FEET COLLAPSIBLE RADIO MAST.

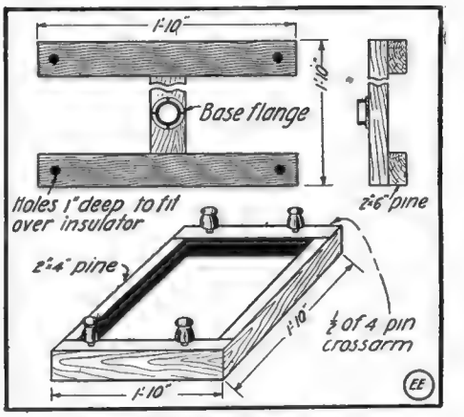
Push a button and, presto—you've got a wireless tower 1,000 feet high. Such a tower is under consideration by the United States War and Navy departments for adoption as part of the new national defense scheme. The inventor is Joseph Raes, an American citizen, native of Belgium, now living in Washington.

The tower is made of steel tubing, like a giant collapsible fishpole. It can be mounted on a concrete base; smaller towers can be attached to motor trucks.

Each tower has guy wires attached to powerful springs, which coil up the guys when the tower is "down." When the tower goes "up" the guy wires and harp strings for the wireless are spread automatically. It is strong enough to bear searchlights, machine guns and signaling apparatus.

INSULATED AERIAL MAST BASE.

To insulate the base of my iron pipe mast I took a four-pin cross-arm and sawed it



Insulated Antenna Mast Base.

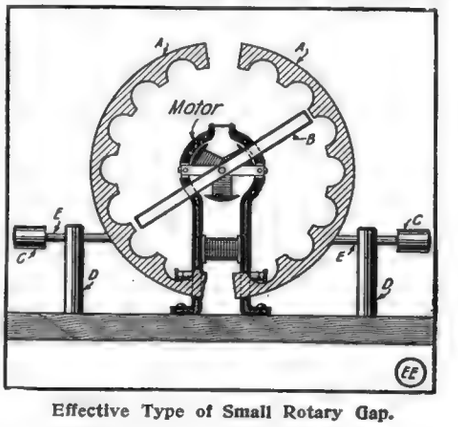
in two. Over this was placed a base made of yellow pine bored to fit down over the insulators about 1 inch. I use high tension porcelain insulators on the pins. By referring to diagram the base can be very easily made.

Contributed by P. F. RUTHERFORD.

UNIQUE ROTARY SPARK GAP.

The parts necessary to construct this rotary gap are as follows: A small motor, a sheet of brass 6 inches square and ⅛ inch thick, two large binding posts, a piece of brass 5x1x⅛ inch, a piece of brass rod 6 or 8 inches long and ⅛ inch in diameter. A—Stationary electrodes, which are cut out of the square sheet of brass. B—Rotating bar, which is fastened on the motor shaft. C—Hard rubber knobs. D—Large binding posts. E—Brass rod.

To operate this gap the rod which is fastened on A is put through the hole in



Effective Type of Small Rotary Gap.

the binding post and then adjusted as near the rotating bar as seems best, and to be found by test. The motor can be a common battery motor.

Contributed by JOHN WEBER, JR.

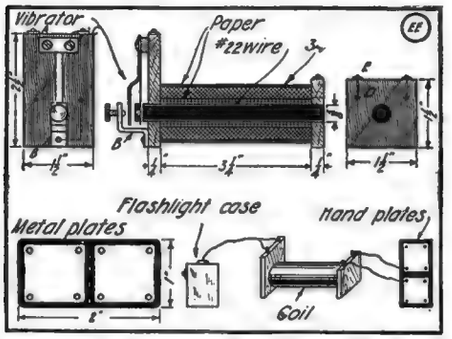
WRECKED.

The explosion of an alcohol tank wrecked the Naval wireless station at Cordova, Alaska, recently and caused the injury of three enlisted men, according to a report received at the Navy Department.

AN ELECTRICAL HAND-SHAKING SURPRISE.

I have decided to contribute an idea of mine with which I have had all kinds of fun. It is a hand-shaking, shocking device which works to perfection. Observe the drawing, which I have made very simple.

The most important thing is the induction coil, which can either be purchased or made as follows: Cut some soft iron wire into 3¾ inch lengths and make up a bundle ⅜ inch in diameter. Cut out two pieces of wood, one 1½ inches square and the other 2½ inches by 1½ inches by ¼ inch. Bore ⅜-inch holes through centers, fit in the core and soak the whole in melted paraffine wax. Now wind on this two layers of No. 22 wire and run the ends out through two small holes in the larger end. This is for the primary and the vibrator, which can be bought or taken out of an old electric bell. One wire goes direct to a screw, A, at the top of the vibrator end, and the other goes to the thumb screw B. The vibrator spring is connected to C. Next wind two layers of writing paper over the primary and glue it. The secondary is next wound on. Make a small hole D in the smaller wood end and run out wire and connect to E. Wind on two and one-half to three ounces of No. 34 magnet wire evenly and connect to other terminal F. Next wind three or four layers of paper over this and glue. So much for the coil. Now cut out a piece of wood 2 inches by 1 inch by ¼ inch and fasten on two metal plates separated about ⅛ inch. Connect a wire to each plate and leave about 3 feet over. Next take a flashlight case and instead of a lamp obtain a miniature attachment plug.



Apparatus for Electrical Hand-shaking Surprise.

To work it put the flashlight case and battery in the left trouser pocket and run the wires from the attachment plug to the primary of the coil, which is placed in a vest pocket, vibrator up. The wires from the hand-plates are run up the right sleeve and connected to the secondary of the coil. To test it, press the button of the flashlight and the buzzer on the coil should start, if not adjust it. Then place the piece of wood with the plates on the palm of the hand and you will feel the shock. When shaking hands with anyone turn the piece of wood so that when the hand is grasped the plates will touch the victim's hand and then watch results! I have used my apparatus for nearly a year and have had great fun with it.

Contributed by E. LASTER.

HINTS ON USING ODDS AND ENDS IN RADIO CONSTRUCTION.

Interest in radio experimenting centers in the ease with which efficient apparatus can be made up by the average boy, who generally has few tools and little cash. Discarded clocks, bells and batteries, and other miscellaneous material, generally classified as "junk," can be worked over into radio sets.

Zinc from old batteries, melted under charcoal, is cast into new zincs; the side binding posts from dry batteries, hacksawed off at the bottom of the slot in the head, and held in a lathe, are filed into shape for switch points. When there is no lathe, a hand drill held in a vise answers the purpose.

Carbons of old batteries are renewed by boiling in clean water. The connecting screws are very useful.

Old wire, from bell magnets, et cetera, can be used for tuner windings; if the insulation is damaged, wind a thread between turns. Sealing wax and a hot soldering iron will fasten the ends.

Old photo films, boiled until clean, make good condenser dielectrics for receiving circuits.

Hard rubber may be softened by inserting it in boiling water; form while hot. Warped pieces may be straightened by heating, and clamping between smooth boards until cold. Any tool used in woodworking will work on rubber, but must not be crowded or forced.

Instruments made of wood should have all metal parts separated from the wood by mica sheets or washers, so that at no point in the circuit does the metal rest on wood.

Use a pure silver wire for "cat-whisker" detectors; all metal parts should be silver-plated, which can be done at home with little trouble. Nickel is a loss.

Exploded cartridge shells can be worked into good detector cups.

Aerial masts can be made nicely of three by one-inch wooden strips, built in a long V shape. Latticed across in four to six-foot lengths, they are light and strong.

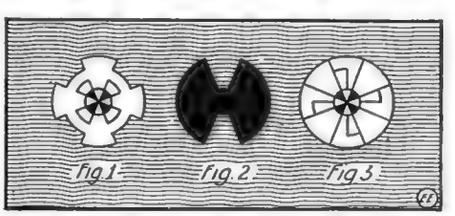
Discarded lengths of the galvanized cable used by electric companies as guy wires, when untwisted in pairs, make excellent guy wires for the ordinary mast.

Aerial ropes boiled in paraffine last longer, without stretching and shrinking from the weather.

Contributed by A RADIO BUG.

AN ELECTRIC DISC ILLUSION.

I give herewith a contribution to the *The Electrical Experimenter*, by which many wonderful and charming color illusions can be produced both day and night. The plan of construction follows: Articles necessary —A small motor, a wooden cabinet, three or four cells of battery, a switch, a sheet of metal and a piece of cardboard about 10 inches long and 7 inches wide. First of all mark out in dotted lines the two revolving color discs as illustrated in Figs. 1 and 3.



Details of Color Discs.

A sharp penknife must be used in order to trim away the edges and ends in the disc illustrated in Fig. 1. Then procure a sheet of brass or metal, mark out and cut out as shown in Fig. 2. In every one of these discs leave a small hole in the center in order to permit their fastening on the shaft of the motor loosely. Then make a sort of cabinet of wood as shown in Fig. 4. In the center of the top of the cabinet drill a small hole in order to pass the shaft of the motor through. After doing this, fasten your motor on a block of wood and again tighten this block, with motor attached, on the base of your cabinet. (See Fig. 4.) Then connect with batteries and switch as usual. At last paint the cardboard discs with a variety of bright hues, each one different, and fasten all three discs on the shaft protruding from the hole you drilled in the cabinet. With the addition of a plate or pane of glass the effects of the colors are greatly increased. This plate or pane can be supported by four felt or rubber-headed tacks driven in at the four corners of the cabinet. By night this outfit may also be used, but the discs must be especially made for this purpose. Cut out neatly and accurately with a sharp penknife all the curves and bends in Fig. 1 and 3, so that a mere outside frame or skeleton of the disc is left. Now take some thin tissue paper and paste it on the back of the skeletons of both discs. Then paint them with various different bright tints. On the top of the cabinet mark out and draw a circle with a compass and drill in as many holes as can be made on the circle just drawn. Then a bulb must be placed under the top, a little aside from the hole where the shaft of the motor pierces the top of your cabinet, in order to emit an even and steady light under the revolving discs. Put your bulb in connection with batteries and your outfit is complete. In order to multiply its charming effects it is advisable to place it in a very dark place. Now, when the switch is thrown, the motor begins to revolve very rapidly, at many thousand revolutions per minute, so that the discs flying around emit charming and various bright colors, owing to the bulb underneath, and when placed in some dark corner of a store window at night it will run for hours, its beautiful effects proving a sure attraction.

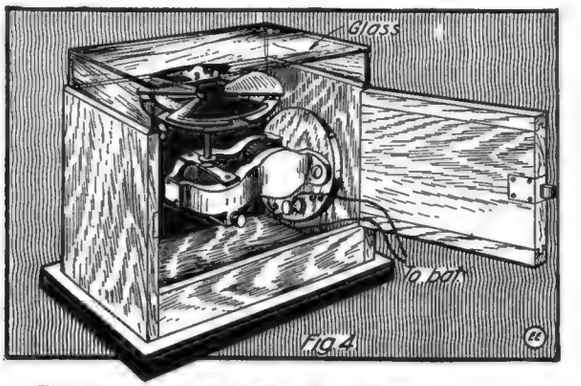


Fig. 4. Assembled Electric Disc Illusion Apparatus.

Contributed by W. WARNECKE, Jr.

RAIN TO ORDER.

The artificial production of rain is about to be put to the test of practice in Australia. According to the *Electrician*, London, experiments are to be carried out by J. G. Balsillie, who has for four years been conducting researches into these possibilities. A captive balloon at a height of 6,000 or 7,000 feet will be used to discharge electricity in two forms to the atmosphere. This, it is hoped, will cause sufficient ionization to provide nuclei upon which the moisture of the clouds may condense. Mr. Balsillie believes that a number of these stations set up in the path of the prevailing winds would draw all the moisture from the clouds carried by them.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR TILL SEPTEMBER, 1916, IN NEW GOVERNMENT CALL BOOK. PRESERVE THIS LIST FOR FUTURE REFERENCE.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of September, 1915. (Continued.)

NINTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
9VR	Eilers, Werner	Gillespie, Ill.	1,000
9VO	Esteling, David A.	1619 S. 8th St., Minneapolis, Minn.	30
9VN	Geiger, Hans F.	3151 Graceland Ave., Indianapolis, Ind.	250
9WD	Giese, Raymond C.	New London, Iowa.	1,000
9VX	Grossman, Eugene F.	Delmar, Iowa	1,000
9AK	Jumiske, Harold W.	241 Wolverine St., Laurium, Mich.	36
9WC	Kannensteine, F. M.	3400 Morgan St., St. Louis, Mo.	100
9VT	Lawrence, Harley C.	Ferrysville, Wis.	36
9GP	Mallarian, Gregory	301 S. 13th St., Fargo, N. Dak.	550
9VQ	Mason, Leroy E.	Alden, Minn.	60
9VV	Messerly, Henry	Staunton, Ill.	1,000
9AW	Niswonger, Elbert E.	R.F.D. No. 8, Fort Wayne, Ind.	220
9WB	Nolan, Guy P.	506 Ewing Ave., Kansas City, Mo.	60
9WG	Parks, Paul B.	1321 Calhoun St., Fort Wayne, Ind.	440
9WH	Reynolds, Wm. D., Jr.	3811 S. Tenth Ave., Minneapolis, Minn.	1,000
9VW	Riedy, Walter L.	237 South St., Houghton, Mich.	30
9VZ	Snarski, J. P.	1302 W. 52d St., Chicago, Ill.	80
9HB	White, Elliott A.	903 Lake St., Columbia, Mo.	1,000

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of October, 1915.

FIRST DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
1US	Achin, Horace, Jr.	30 Smith St., N. Attleboro, Mass.	100
1VZ	Becker, Carl W.	56 Brookside Ave., Boston, Mass.	100
1UR	Briggs, Stuart M.	94 Walnut Pl., Brookline, Mass.	100
1RS	Buzzelle, Alfred R.	89 Kinnaird St., Cambridge, Mass.	36
1AR	Couri, Arthur N.	1 Monument St., Portland, Me.	250
1QS	Croft, Theodore C.	10 Winthrop St., Everett, Mass.	100
1AE	Dow, Harrison L.	61 Oliver St., Rockland, Me.	15
1VG	Dow, John A.	20 Woburn St., Reading, Mass.	100
1RP	Duchemin, Albert W.	26 Pond St., Greenfield, Mass.	45
1TW	Fogg, George F.	52 Upham St., Melrose, Mass.	100
1UJ	Frost, Edgar W.	2 Sheffield St., Pepperell, Mass.	100
1PR	Golder, John	1 Ivy St., Boston, Mass.	100
1WI	Grant, Alfred A.	571 Washington St., Brighton, Mass.	100
1KX	Holt, Clarence J.	26 Trenton St., Melrose, Mass.	40
1RA	Hood, Ralph S.	7 Ash St., Danvers, Mass.	100
1WF	Lefave, Stanley J.	130 Tremont St., Melrose, Mass.	100
1VK	Lynn Eng. High School	Highland Sq., Lynn, Mass.	1,000
1LC	Mass. Inst. Technology.	Boston, Mass.	500
1VF	Mayer, Arthur W.	7 Chestnut St., Jamaica Plain, Mass.	100
1VD	McMahon, John F., Jr.	56 West Ave., South Norwalk, Conn.	100
1SQ	Morrison, H. R.	137 Ingham St., Willimansett, Mass.	100
1FB	Saunders, Frank	Richmond, Me.	300
1QU	Shortis, John	5 Chelsea St., Charlestown, Mass.	100
1VS	Steadman, Robt. C.	31 Park Road, Brockton, Mass.	100
1TA	Tucker, Cecil A.	21 Church St., Lynn, Mass.	27
1VA	Wickes, Henry W.	Pleasant St., Winthrop, Mass.	100

SECOND DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
2EG	Aranyi Egmont	123 W. 112th St., New York, N. Y.	10
2GL	Ashley, George	Chatham, N. Y.	500
2DL	Bangert, V. F., Jr.	34 Orchard St., Jamaica, N. Y.	24
2CZ	Becker, Frank	12 Callister St., New York, N. Y.	440
2GF	Brockman, F. C.	226 Walnut St., Roselle Park, N. J.	700
2FQ	Connor, Harold G.	827 3d Ave., North Troy, N. Y.	28
2CF	Derx, Martin, Jr.	253 Vernon Ave., Brooklyn, N. Y.	720
2EZ	Donohue, Peter J.	103 W. 60th St., New York, N. Y.	30
2FK	Freure, Richard W.	439a McDonough St., B'klyn, N. Y.	30
2GR	Gardell, Emil C.	Oakhurst, N. J.	500
2BQ	Guild, Baldwin	495 Mt. Prospect Ave., Newark, N. J.	200
2EV	Hajoz, Eugene	626 Trinity Ave., New York, N. Y.	550
2BO	McIntire, Meylert A.	1127 Avenue G, Brooklyn, N. Y.	500
2GM	Moss, Sidney W.	56 Taylor Pl., South Orange, N. J.	500
2GI	Murphy, Dennis	9 Ingram St., Yonkers, N. Y.	30
2DQ	Porter, Roland	169 E. 74th St., New York, N. Y.	10
2CD	Robbins, Wm. E., Jr.	614 5th Ave., Upper Troy, N. Y.	27
2AH	Roche, Walter J.	2 Irving Pl., Jamaica, N. Y.	1,000
2AU	Schram, John, Jr.	283 E. 32d St., Brooklyn, N. Y.	60
2BI	Slater, Harry	156 19th St., Brooklyn, N. Y.	—
2FM	West, Gilmore C.	59 6th Ave., Long Branch, N. J.	225

THIRD DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
3CY	Biser, Marx H.	Middletown, Md.	25
3KE	Brubaker, John W.	200 W. 16th St., Philadelphia, Pa.	500
3BA	Carrington, Roland	347 Camel St., Baltimore, Md.	36
3IW	Fisher, John T.	136 York Ave., W. Cape May, N. J.	36
3JV	Gardner, James A.	14 1st Ave., West Catasauqua, Pa.	24
3EX	Gray, Karl F.	113 Northampton St., Easton, Pa.	500
3IS	Hartley, Milton E.	635 E. St. N.E., Washington, D. C.	50
3KP	McKinley, Richard S.	218 Lansdowne St., Wayne, Pa.	100
3KG	Patterson, John E.	2835 N. Bailey St., Philadelphia, Pa.	60
3JA	Presbrey, Victor E.	Vineland, N. J.	24
3GD	Sener, C. Edward, Jr.	2706 24th St., N.E., Washington, D.C.	60
3IU	Silver, Paul B.	210 Lansdowne St., Philadelphia, Pa.	250
3IP	Williamson, Chas. M.	Hampton, Va.	50

FOURTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
4AJ	Featherton, Joe A.	Honea Path, S. C	1,000
4BS	Henshaw, Howard	Miami, Fla.	24
4BI	James, F. Leslie	211 Lee St., Tampa, Fla.	20
4BO	Megee, Benjamn R.	63 Mansfield St., Atlanta, Ga.	550
4BW	Newell, William F.	828 5th Ave., N., St. Petersburg, Fla.	250

FOURTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
4BV	Saeger, Raymond A.	Ankona, Fla.	170
4CW	Taft, Robert B.	105 Rutledge Ave., Charleston, S. C.	495
4BP	Whitaker, A. Klein.	210 Stanton St., Bradentown, Fla.	500
4BM	Williams, Emory C.	Kirdwood, Ga.	770

FIFTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
5DH	Andress, Max	735 N. Robinson St., Cleburne, Tex.	18
5DI	Hanz, Harry W.	310 Bridge St., New Braunfeld, Tex.	250
5DJ	Richard, Chas. L.	1004 Government St., Mobile, Ala.	500

SIXTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
6CV	Anderson, Donald S. C.	154 Texas St., Redlands, Cal.	100
6AW	Cullen, Paul K.	R.F.D., No. 1, Long Beach, Cal.	600
6LU	Oliver, Leslie H.	1116 Catalina Ave., Pasadena, Cal.	165
6DV	Taenzer, Ernest M.	801 Brent Ave., S. Pasadena, Cal.	330
6CX	Whitehead, Stanley K.	138 N. Ohio St., Los Angeles, Cal.	330

SEVENTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
7AC	Dailey, A. C.	3915 Colby St., Everett, Wash.	1,000
7DO	De Guire, Olfan	Silverton, Ore.	250
7FF	Farris, Frank E.	1010 Spring St., Olympia, Wash.	450
7LJ	Harder, Louis	360 Hancock St., Portland, Ore.	220
7JI	Harding, Jas. R.	343 Commercial St., Salem, Ore.	1,000
7BQ	Howard, Cecil C.	408 Benton St., Portland, Ore.	250
7JL	Jones, Lloyd W.	134 E. 45th St., Portland, Ore.	124
7KR	Keefe, Robert M.	121 Avenue D, Snohomish, Wash.	140
7WJ	Kennedy, William	Tillamook, Ore.	100
7HL	Longmire, Harold D.	408 32d St., South, Tacoma, Wash.	495
7DL	Mason, Dwight A.	817 N. 13th St., Tacoma, Wash.	500
7JQ	Ray, James	2028 6th Ave., Seattle, Wash.	440
7AP	Rosedale, Archie E.	267 9th St., Astoria, Ore.	100
7MA	Wiley, Irving R.	1214 E. Madison St., Portland, Ore.	50
7BW	Williams, Chas. E.	8396 13th Ave., N.W., Seattle, Wash.	250
7CW	Willius, Charles	1400 E. Stark St., Portland, Ore.	124

EIGHTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
8RL	Alexander, Frank	34 Asbury St., Rochester, N. Y.	12
8NU	Barker, Gilroy	2901 W. Liberty Ave., Dormont, Pa.	500
8QE	Barnhart, Walter	Beaver, Pa.	250
8KF	Beck, Frank G.	119 Penn. Ave., Greensburg, Pa.	750
8NJ	Crumbie, Goodwin B.	Plymouth, Mich.	36
8MQ	Duff, Cuthbert	Norwood, Ohio	50
8QK	Gould, Henry W.	Oberlin, Ohio	1,000
8PZ	Guy, Fred E.	24 Jewel St., Rochester, N. Y.	27
8OG	Hinton, Don	Cambridge, Ohio.	36
8LJ	Linxweiler, Carl J.	140 Eagle St., Dayton, Ohio	20
8HI	McCracken, Harold J.	1540 12th St., Detroit, Mich.	500
8NQ	McMunn, J. Homer	Cambridge, Ohio.	250
8QM	Milyo, Stephen	Mount Carmel, Pa.	24
8NE	Mosteller, Floyd	E. Stroudsburg, Pa.	500
8KV	Schramm, Joseph H.	927 Highland Ave., Pittsburgh, Pa.	48
8DC	Schulder, Arthur	6110 Utica Ave., Cleveland, Ohio	420
8KL	Smith, Raymond	Tippecanoe City, Ohio.	60
8GK	Tomlinson, Geo. E.	520 Crawford St., Grand Rapids, Mich	27

NINTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
9GA	Case, Henry W.	Wheeler, Ill.	33
9GF	Eyth, Hector G.	2325 Arapahoe St., Denver, Colo.	12
9RI	Flesvig, Henry	743 W. 26th St., Chicago, Ill.	500
9JU	Gisseler, Herman	2828 Fletcher St., Chicago, Ill.	150
9HT	Gleichman, Walter C.	2006 Fulton Ave., Evansville, Ind.	275
9JS	Goodnetter, Elmore F.	1500 Grand Ave., Racine, Wis.	250
9SR	Hogan, Lee	458 11th Ave., Milwaukee, Wis.	18
9HY	Keffer, Allen W.	Ashland, Ky.	250
9GJ	Lavender, Edwin N.	7363 Maple Blvd., Maplewood, Mo.	550
9GE	McKee, Myron J.	2213 N. New Jersey St., Indianapolis	275
9GS	Morgan, Berwyn E.	506 E. Cherry St., Watseka, Ill.	36
9GW	Rock, Burnham S.	5921 Winthrop Ave., Chicago, Ill.	550
9GB	Taylor, Wm. B., Jr.	6638 Kenmore Ave., Chicago, Ill.	550
9IS	Wendell, Raymond B.	908 Clark St., Evanston, Ill.	363
9II	Wilshusen, Wilmer L.	Stafford, Kans.	750

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of November, 1915.

FIRST DISTRICT.

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
1AAT	Allen, Laurence H.	60 Dean St., Attleboro, Mass.	.5
1AAE	Baker, Warren F.	2 Baker Pl, Dorchester, Mass.	.5
1AAL	Burt, Jairus F.	66 Pine St., Pittsfield, Mass.	.5
1AAV	Carter, Geo. T., Jr.	686 Massachusetts Ave., Boston	.5
1AAO	Cheever, Walter G.	6 Aldersey St., Somerville, Mass.	.5
1AAJ	Custeau, Harry G.	24 Clark St., Cambridge, Mass.	.5
1AAF	Drew, Wililam E.	324 Central Ave., Auburndale, Mass.	.5
1AAY	Etter, Earle F.	25 Bickerstoff St., Boston, Mass.	.5
1AAK	Fowle, Herbert L.	Woodward Ave., Reading, Mass.	.5
1AAG	Ghen, Melville W.	64 First St., Melrose, Mass.	.5
1AAI	Gray, Arthur	59 Regent St., Roxbury, Mass.	.5
1VT	Hill, William J.	691-A Columbia Rd., Dorchester, Mass	.5
1AAB	Massey, John C.	3 Whitwell Ave., Newport, R. I.	.5
1AAN	McNamara, Fred'k W.	23 Alpine St., Arlington, Mass.	.5
1UY	Merritt, Hyland E.	18 Lowden Ave., Somerville, Mass.	.5
1AAD	Needham, Raymond W.	10 Grove St., Pittsfiield, Mass.	.5
1QJ	Noble, Lewis C.	35 Wdln Ave., Wellesley Hills, Mass	.5
1VY	Park, Francis E., Jr.	359 Main St., Stoneham, Mass.	.5
1AAH	Pinnington, William	71 Jouvett St., New Bedford, Mass.	.5
1AAC	Prinz, Julius C.	5 Charles St., Newport, R. I.	.5
1BE	Wadsworth, Philip S.	8 Hanover St., Portland, Me.	.5
1VP	Whipple, Harold B.	172 Park St., Medford, Mass.	.5
1AAW	Winant, Alvin C.	West Medway, Mass.	.5

SECOND DISTRICT.

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
2FO	Blanchard, Wesley S.	170 Jersey St., New Brighton, N. Y.	.5
2HV	Collignon, Francis A.	352 Willett Ave., Port Chester, N.Y.	.5
2HT	Dunn, Alan C.	62 Edgecombe Ave., New York, N.Y.	.5
2ID	Miller, John W., Jr.	119 Smith St., Peekskill, N. Y.	.5
2HJ	Muller, Julius A., Jr.	301 Union Ave., Mt. Vernon, N. Y.	.5
2IV	Smith, Nelson M.	143 Horton Ave., Port Chester, N.Y.	.5
2HS	Stewart, Douglass	90 N. Broadway, Yonkers, N. Y.	.5

(To be continued.)

HOW TO MAKE IT

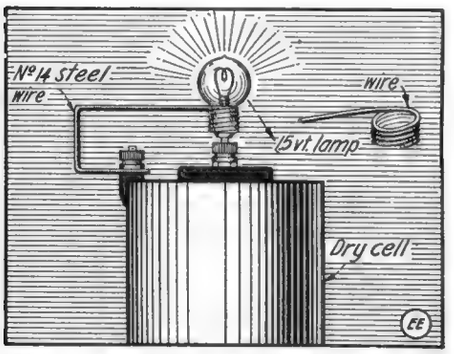
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

SECOND PRIZE $2.00.

A HOME-MADE BATTERY LAMP.

Bend one end of a 6-inch piece of No. 22 steel wire into a spiral large enough to allow a miniature lamp to be screwed into it. Do the same to the other end, only make the loop just large enough to slip over a zinc binding post on a dry cell. It is best to twist the ends. About 1½ inches from the large loop bend the wire at right angles. About ¼ inch from the smaller loop bend the wire so that it makes a square corner. Put the fixture on an ordinary dry cell. The bottom contact of the lamp should not quite touch the carbon binding post. By holding the battery in a horizontal position with the hand and by merely pressing on the wire the light will burn brightly. Although this design is simple it is quite efficacious.

Contributed by SHELBY BLONG.



Battery Lamp Holder and Switch Formed from Piece of Steel Wire. Beat It!

AN EMERGENCY FUSE PLUG.

While experimenting with the 110-volt house lighting current recently I accidentally blew out the fuse. As I had no extra ones on hand, and no time to go to town after another, I decided to make one the best way I could. Procuring an old burnt-out 16 candlepower carbon lamp I broke the bulb and removed all the pieces of glass from the base. I also took out the broken filament, which left the brass base with a small glass tube holding the two platinum wire supports. The ends of these supporting wires I cleaned with a file. I then carefully twisted the wires together and put a drop of solder on the joint.

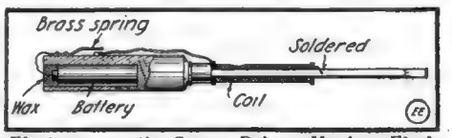
After throwing open the switch I removed the regular fuse plug, containing the burnt-out fuse, and screwed my home-made fuse in, which I found to work excellently. It is obvious, however, that the switch should be open when inserting this makeshift fuse, as the brass base offers no insulation against a shock.

Contributed by MURIEL MURTAUGH.

FIRST PRIZE $3.00.

IMPROVED ELECTRO-MAGNETIC SCREW DRIVER.

Bore a hole into the handle of the screw driver the size of the cell used in a vest pocket flashlight battery. This hole will be about 3 inches deep by ⅝ inch in diameter. Solder a piece of fine wire to one pole of



Electro-magnetic Screw Driver Having Flash-light Battery in Handle.

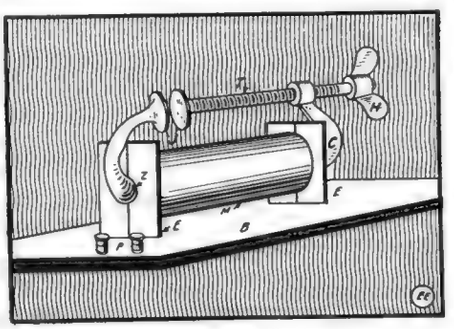
the cell, and insert it into the handle far enough to come in contact with the inner end of the screw driver blade. Fill in the end with a wood plug and bring the end of wire through its center. With small brass screws fasten a thin brass strip to the handle and attach the wire to it. Then put another screw into the handle and attach a wire from the coil to it. The other end of the wire is soldered to the screw driver itself.

Having the battery in the handle of the tool will make it more useful and easier to carry than the one which was previously described in these columns, where the plan was to carry two or more standard dry cells with the screw driver, I believe.

Contributed by C. A. SHEPHARD.

ADJUSTABLE MAGNETIZER MADE FROM WOOD CLAMP.

An ordinary furniture clamp of suitable size is fitted with two square wooden pieces, cut as at Z, in the figure. These pieces are placed around the shank of the clamp to serve as magnet ends. The split blocks are then joined with glue and allowed to dry. Wire of the proper size to obtain the desired magnet strength is next wound neatly between the ends E, E. The magnetizer is glued to a suitable base and is supplied with binding posts P. In using



An Adjustable Magnetizer Made from Iron Wood Clamp.

it the handle H is rotated until the desired distance is obtained.

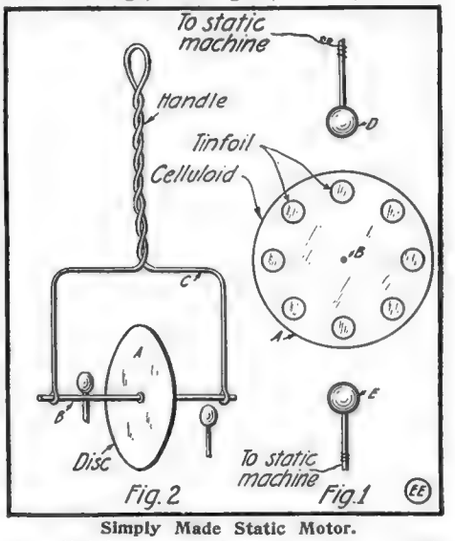
Contributed by A. D. R. FRASER.

THIRD PRIZE $1.00.

A SIMPLE ELECTROSTATIC MOTOR.

The little motor illustrated and described below is entertaining as a scientific toy and also serves to show how motion may result from an electrostatic field. It has the further advantage of costing practically nothing.

Fig. 1 shows the moving parts, which consists of a disc of stiff celluloid A, two inches in diameter. A large hatpin B (minus the head) is passed through the center and forms an axle, projecting an equal distance on either side of the disc. This may be secured with two little dabs of sealing wax, carefully applied. Eight small circles of tinfoil are stuck at equal distances near the edge, either gum, shellac, varnish



Simply Made Static Motor.

or celluloid cement being used as an adhesive. If the disc is suspended so as to be free to revolve, and brought between the discharging balls of a Wimshurst machine D and E, separated to a distance of about three inches, it will rotate at a considerable speed upon working the machine. Usually the motor starts at once, but the writer has found that it is sometimes necessary to start it with the finger if the tinfoil circles happen to be exactly in line with the electrodes.

A convenient form of support is shown in Fig. 2, where A represents the celluloid disc, B the steel axle and C a handle bent from a piece of thin copper wire. The two arms supporting the axle should be at least three inches long and as wide apart as the length of the axle admits. If preferred, a little stand may be made with a wooden base and two uprights, the height of the latter being adjusted to suit the Wimshurst machine with which the motor is to be used.

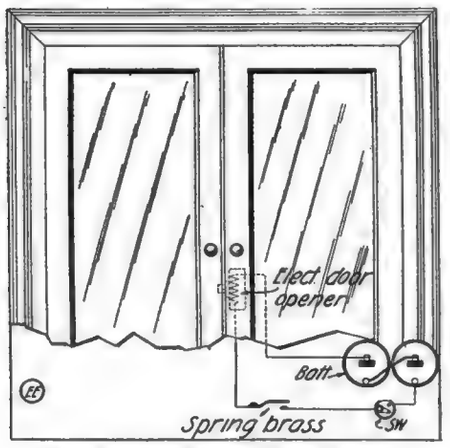
Contributed by H. I. GRAY

NOVEL USE OF DOOR OPENER.

Having frequently to go in the cellar and return with my arms full, I devised the following scheme whereby I can open the door without emptying my arms, although to a stranger the door is securely locked.

An electric door opener was put on the door and connected as an ordinary door opener, the only difference being that instead of going to a push button the wires led to a secret contact of spring brass, which was put in an out-of-the-way corner under the carpet.

When I wish to open the door I step on



Foot Operated Electric Door Opener.

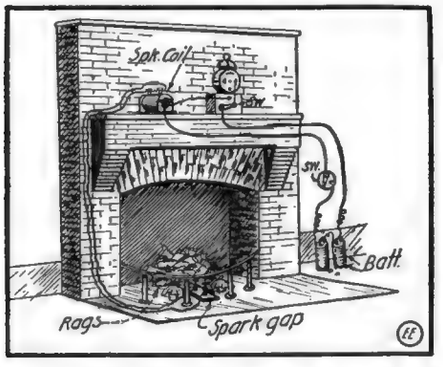
the secret contact and the push-out spring opens the door.

Contributed by CARL T. LUDWIG.

AN ELECRIC FIRE STARTER.

This electric fire starter prevents having to get up on a cold morning to start same.

All that is required is a spark coil of any size, enough batteries to operate the coil, an alarm clark, a battery switch, a box 8x3 inches, a tin pan, two cork stoppers and two needles. The stoppers are fastened to the bottom of the pan and the needles stuck through the corks, making a spark gap. The gap is connected to the coil and set under the grate. Some rags are bundled up tight and soaked in gasoline or turpentine and put just under the gap.



Alarm Clock and Spark Coil Start Fire in Morning. Spark Gap Should Be Protected With Asbestos to Prevent It Being Burned Up.

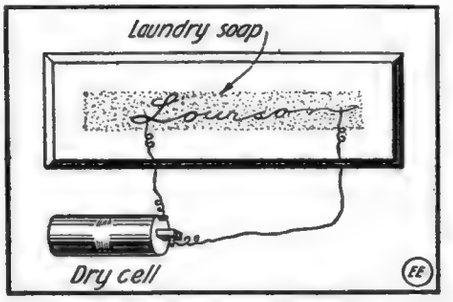
Over the rags are placed some splinters, and then wood and coal.

The alarm clock is wound and set and a loop put in a string over the alarm thumbscrew on the back of the clock. The other end is attached to a small switch coming from the batteries. The other wire from the batteries goes to the spark coil, and the opposite end of the switch connects to the coil. When the clock goes off, the thumbscrew will revolve, close the switch and start the coil. The spark will light the rags under the grate and start the fire.

Contributed by J. WESLEY BROWN, JR.

HOW TO DO ELECTRICAL ETCHING.

Following is a little experiment which



Simple Electric Etching Scheme.

can be successfully carried out by carefully following the directions herewith given. It will prove quite interesting, and will insure the object thus etched against theft, etc.

A few cents' worth of bluestone is procured and dissolved in one part of water, to which is added two tablespoonfuls of salt. Clean well the object to be etched. Next, with a piece of ordinary yellow laundry soap, coat the surface until a thin film of the same is applied. Then take a sharp-pointed pin and scrape, in one continuous path, the name or initials, etc., desired to be etched in and pour on the solution until the object to be etched is covered. The drawing explains at a glance the next step, and that is to connect a dry battery, with both wires from zinc and carbon in the solution. Leave thus for a few minutes.

Then rub off the soap with a rag, and the name, initial or whatever was scraped on the object, will appear. It is copper-coated and "etched in."

This little hint is invaluable for the laboratory or shop, where the owners of tools often lose, miss and hunt for their instrument. This mark is indelible and cannot be altered or taken out.

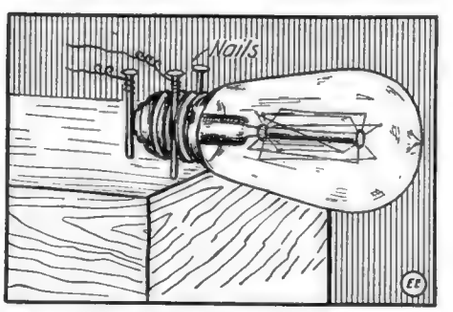
Contributed by WILLIAM WARNECKE, JR.

THE SIMPLEST LAMP SOCKET.

This emergency lamp socket is made in three seconds by driving two nails into the side of a piece of wood the right distance apart for the base of a lamp bulb to screw between, and one nail placed ¾ inch distant and at a point perpendicular to the other two.

A connection is made to one of the side nails and the other connection is made to the back nail. See cut.

Contributed by W. F. ALLSTON.



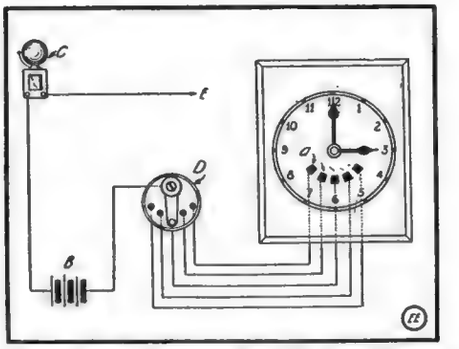
Simplest Lamp Socket. Made from Three Nails.

(If a lamp "socket" can be made of less material than the above we would like to see it!.—Ed.)

A PRACTICAL ELECTRIC ALARM CLOCK.

This is a rough but practical way in which to make a useful alarm clock.

At A are especially shaped brass or tin contacts. B is the battery, C a bell. D is the switch controlling the points on the clock. E is the wire which is to be connected to frame of clock, and completes the circuit when the hour hand strikes the metal points A. Caution: Let only the hour hand strike the contacts. The points will have to be adjusted so as to make the bell ring at the correct time, and of the proper height to allow the hand to pass over them after making contact. The



Useful Alarm Attachment for Any Clock. Switch Shown Permits Ringing Bell at Any Desired Time.

switch D may be placed in any convenient place. Another switch may also be put in series with the bell and placed close to the bed to facilitate the turning off of the bell without getting up. This switch should remain closed normally. I installed one of these clocks recently and it works very successfully. Contributed by

NORMAN W. BROWN.

FLASHLIGHT FOR ILLUMINATING DARK CLOSETS.

An ordinary flashlight can often be handily arranged so it will light a dark closet, wardrobe or pantry. It is supported on a hook or a nail inside of the closet, and a spring switch with extending rod, similar to a burglar alarm switch, may be placed on

Door-Controlled Spring Switch Used to Close Flashlight Circuit When Closet Door is Opened: Extinguishes It When Door is Closed.

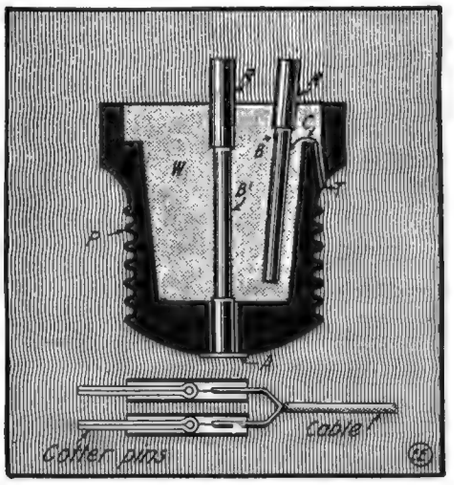
the door jamb. When the door is closed the spring will be separated and the light will be extinguished, but when the door is opened the spring switch closes, lighting the closet or pantry, as the case may be. Ordinary bell wire will be found suitable for making connections between the switch and the flashlight. This form of illumination will be found efficacious in solving many other lighting problems of a similar nature.

Contributed by B. J. SARTER.

USEFUL ATTACHMENT PLUG.

This plug may be made from an old plug type fuse with the brass top removed. The thread and one brass tube should be connected by a wire through the channel usually found on such plugs. To connect wires to this plug, cotter pins of suitable size should be employed. The accompanying sketch depicts the different parts of the plug.

At P is an old fuse plug; B^1, brass tube soldered to contact rivet A; B, brass tube with wire from thread of "plug" soldered to it; C, connecting wire; T, connecting



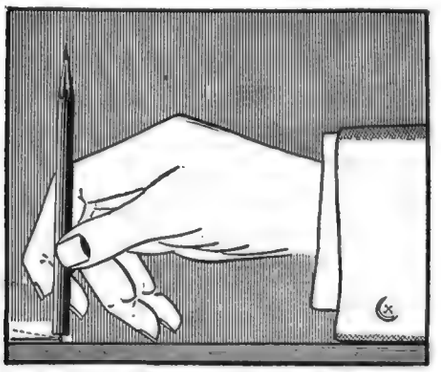
Separable Attachment Plug Made Out of Old Fuse Plug.

wire soldered to thread; R R, rubber tube to insulate B^1 and B; W, sealing wax.

Contributed by A. D. R. FRASER.

MORSE SOUNDER FROM A "PIN."

As a reader of your interesting review I beg to enclose the sketch of an idea of mine which up to the present I believe is not known, and perhaps it may be of interest to students of the Morse code. Place the bottom part of a pencil on the head of a small pin (on a table or other hard surface) and move the pencil, as shown in diagram, which will actuate as a sounder



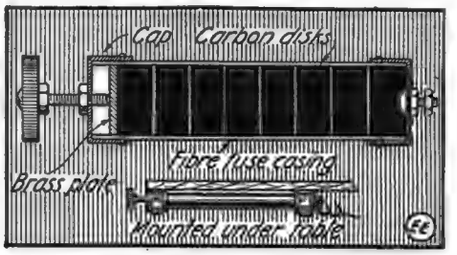
A "Pin" Sounder That Works! Try It.

for practising the Morse code. Contributed by ANTONIO CORNISH-BESA,
Valparaiso, Chile.

A CARBON RHEOSTAT IN A CARTRIDGE FUSE SHELL.

Carbon rheostats are slowly but surely finding their place in the electrical field. Working on the principle of imperfect contact, they have the fine adjustment of a water rheostat without the attendant gases, while they are as easy to handle as a metal resistance and will carry a heavier current than a wire rheostat of the same weight, besides being very compact.

They can be made cheaply and in any size for your needs, but I will limit my description to a small one suitable for use in charging storage batteries, controlling small motors, or as a ballast for a small arc lamp.



Rheostat Composed of Carbon Discs in Fuse Shell.

Obtain a blown fuse cartridge shell whose internal diameter is the same as the diameter of the round carbon rods you should procure from some old, dry cells. Remove one fuse cap, take out the fireproof filling and any wires remaining at the ends.

Now take the carbon rod and carefully cut it up into ¼-inch lengths. The cuts should be straight across, so the discs will lay close together inside the tube. These discs are piled on top of one another till the tube is nearly full.

Connections are made to the two caps, one of which has an adjusting screw threaded through it to enable the operator to regulate the pressure between the discs.

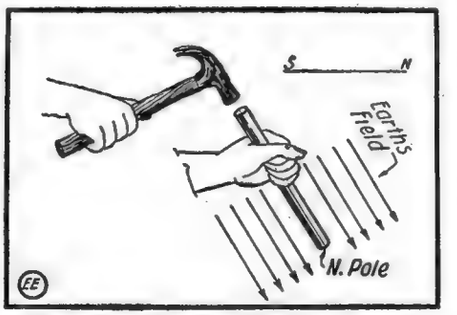
The sketch makes a lengthy explanation unnecessary, but it is advisable to use the system of mounting suggested, as otherwise when pressure would be applied by turning the knob the caps would be forced off the end of the fiber tube.

Contributed by
THOS. W. HANSON.

CURIOUS EXPERIMENT IN MAGNETISM.

One of the simplest yet most puzzling experiments in magnetism can be performed with a rod of machine steel held in the earth's magnet field. It is well known that it is difficult to free iron completely of magnetism. That is, it is almost impossible to completely demagnetize it. For this experiment a piece of very soft machine steel is desirable.

If a small compass is brought near one end, the North seeking pole will be found to be either attracted or repelled. At the other end the reverse condition will be obtained. Hold the rod of iron in the earth's field, whose general direction is North and South, and strike one end with a hammer, as perceived from illustration. The end of the rod which is pointed North will become a North magnetic pole. If the rod is reversed and a blow struck on the end with the hammer, the magnetism in the rod will be found reversed. This is tested for by means of a compass needle.

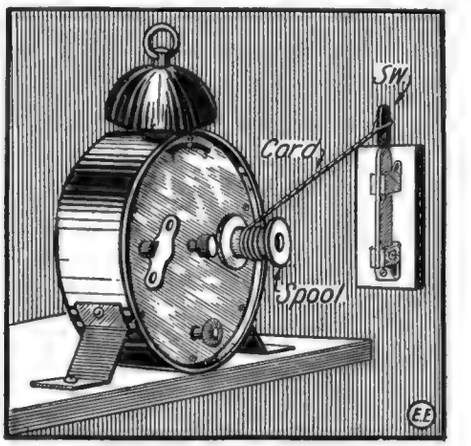


Interesting Experiment in Magnetism.

As the earth's field is not parallel with the surface of the earth, better results will be obtained if the rod is pointed toward the earth, at an angle of say 60 degs., care being taken to keep the rod in a general North and South direction.

NOVEL ELECTRIC TIME SWITCH.

First procure an alarm clock. Take the winding key off the alarm pinion shaft and fasten a spool to it by means of a brass bushing. Next obtain a common knife switch. Arrange the clock and switch as shown in sketch. Fasten the cord to the switch and then close it; next wind the alarm and fasten the other end of the cord to the spool. Wind the alarm and set at the desired time for turning off the switch, and when the alarm goes off the switch will be pulled open. This switch has been used with much success on store window lights.

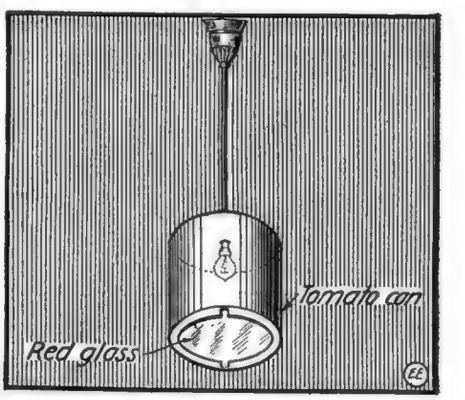


Alarm Clock Opens Switch at Any Desired Time.

Contributed by J. T. DRAIN.

RED LIGHT FOR PHOTO DEVELOPING ROOM.

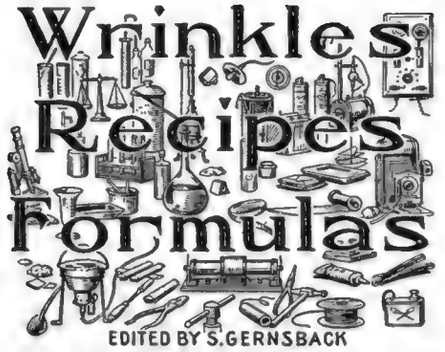
A tomato can when opened leaves a rim about ⅜ inch wide. Flatten this rim and cut out notches for passing a red glass disc through. Put a hole in center of the top cover for wire to incandescent light, as shown in drawing.



Ruby Lamp Made Out of Tomato Can.

Contributed by
NICHOLAS ACCARDI.

Connect a Geissler tube across your primary leads. It will protect the set from heavy static surges and lightning. You can't expect to make a good joint by merely twisting the wires—solder them.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 18.

Solders.

1. *Plumbers' Solder.—Lead,* 2 parts; *Tin,* 1 part.

2. *Tinmen's Solder.—Lead,* 1 part; *Tin,* 1 part.

3. *Zinc Solder.—Tin,* 1 part; *Lead,* 1 to 2 parts.

4. *Spelter Solder.*—Equal parts *Copper* and *Zinc.*

5. *Glazier's Solder.—Tin,* 3 parts; *Lead,* 1 part.

6. *Solder for Copper.—Copper,* 10 parts; *Zinc,* 9 parts.

7. *Brass Solder.—Copper,* 61.25 parts; *Zinc,* 38.75 parts.

8. *Brass Solder, White.—Copper,* 57.41 parts; *Tin,* 14.60 parts; *Zinc,* 27.99 parts.

9. *Black Solder.—Copper,* 2 parts, *Zinc,* 3 parts; *Tin,* 2 parts.

10. *Cold Brazing Without Fire or Lamp. —Fluoric Acid,* 1 oz.; *Oxy-muriatic Acid,* 1 oz.; mix in a lead bottle. Put a chalk mark each side where you want to braze. This mixture will keep about six months in one bottle.

11. *To Solder Iron to Steel or Either to Brass.—Tin,* 3 parts; *Copper,* 39½ parts; *Zinc,* 7½ parts. When applied in a molten state it will firmly unite metals first named to each other.

12. *Plumbers' Solder.—Bismuth,* 1 part; *Lead,* 5 parts; *Tin,* 3 parts; is a first-class composition.

13. *Solder for Brass That Will Stand Hammering.—Brass,* 78.26 parts; *Zinc,* 17.41 parts; *Silver,* 4.33 parts; add a little chloride of potassium to your borax for a flux.

14. *Solder for Steel Joints.—Silver,* 19 parts; *Copper,* 1 part; *Brass,* 2 parts. Melt all together.

15. *Hard Solder.—Copper,* 2 parts; *Zinc,* 1 part. Melt together.

16. *Solder for Brass.—Copper,* 3 parts; *Zinc,* 1 part; with *Borax.*

17. *Solder for Copper.—Brass,* 6 parts; *Zinc,* 1 part; *Tin,* 1 part; melt all together well and pour out to cool.

18. *Solder for Iron.*—The best solder for iron is good tough brass with a little borax.

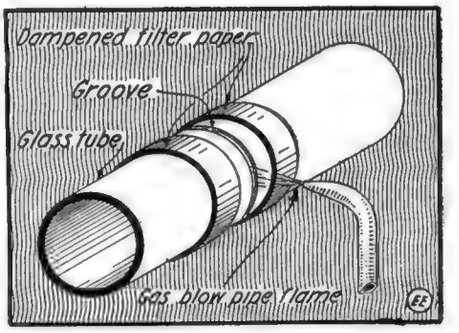
N. B.—In soldering, the surfaces to be joined are made perfectly clean and smooth, and then covered with sal-ammoniac, resin or other flux, the solder is then applied, being melted on and smoothed over by a tinned soldering iron.

Soldering Fluid.—Take 2 oz. *Muriatic Acid;* add *Zinc* till bubbles cease to rise; add ½ teaspoonful of *Sal-Ammoniac.*

S. G.

HOW TO CUT GLASS TUBING.

To many, or rather most experimenters, it is a difficult thing to cut glass tubing larger than a half inch in diameter. Sizes under this can be broken after being cut or nicked slightly with a file. The method I will explain is that used in most chemical laboratories. To illustrate, say the tube is about an inch and a half or so in diameter. The required length of tubing is measured off and then a groove is cut around the tube with the corner of a file. This must be rather deep. Then a piece of filter paper is folded so as to be about two inches wide and long enough to go around the tube. The paper is then moistened. This and a similar piece are placed one on each side of the groove, leaving about a quarter of an inch between the two. A flame from a bunsen burner or blow pipe is then applied to the groove and it will be found that the tube breaks evenly along the file cut. Another method that can be used on smaller tubing, about half inch in diameter, is to make a cut as described and then apply a red hot piece of iron to one spot on the cut.



Easy Way to Cut Glass Tubing.

(A very simple method to accomplish the above is the following: Take a thick piece of string and soak it well in alcohol. Tie it around the part where tube is to be cut. Now light the string. The second it extinguishes dash a drop of cold water on it. A sharp, even break of the tube is the result. We have thus "cut" off the necks of large bottles.—*Editor.*)

Contributed by SYBEREN NYDAM.

CEMENTING GLASS TO METALS.

(1) A cement of great adhesive property, particularly serviceable in attaching the brass mountings on glass lamps, as it is unaffected by petroleum, may be prepared by boiling 3 parts of rosin with 1 part of caustic soda and 5 parts of water, thus making a kind of soap which is mixed with one-half of its weight of plaster of Paris. Zinc white, white lead, or precipitated chalk may be used instead of the plaster, but when they are used the cement will be longer in hardening.

(2) A cement for such purposes as fixing metal letters to glass windows consists of copal varnish 15 parts, drying oil 5 parts, turpentine 3 parts, oil of turpentine 2 parts, liquefied marine glue 5 parts. Melt in a water bath and add 10 parts dry slaked lime.

(3) Brass letters may be securely fastened on glass windows by the following recipes: Litharge 2 parts, white lead 1 part, boiled linseed oil 3 parts, gum copal 1 part. Mixed just before using this forms a quick drying and secure cement.

(4) One pound of shellac dissolved in a pint of strong methylated spirit, to which is to be added 1-20 part of a solution of india rubber in carbon bisulphide.

(5) Take 2 ozs. of a thick solution of glue and mix with 1 oz. of linseed oil varnish, or ¾ oz. of Venice turpentine. Boil together, agitating until the mixture becomes as intimate as possible. The pieces cemented should be fastened together for a space of 48 to 60 hours.

(6) One of the best cements for uniting glass to other substances is prepared by putting the best and purest gum arabic into a small quantity of water and leaving it till next day, when it should be of the consistency of treacle. Calomel (mercurous chloride or subchloride of mercury) is then added in suitable quantity, enough to make a sticky mass being well mixed on a glass plate with a spatula. No more is to be made than that required for immediate use. The cement hardens in a few hours, but it is wiser to leave it for a day or two. To insure success it is necessary to use only the very best gum; inferior sorts are absolutely useless.

(7) Before glass can be soldered to metal it must be "quicked" upon the side that is to be soldered. The "quicking" process is similar to, if not identical with, the method of silvering a looking glass. When the glass is "quicked" it may be readily soldered to the metal, using Venice turpentine or chloride of zinc as a flux.

(8) Sixty parts starch, 100 finely pulverized chalk are made into a mixture with equal parts of water and spirit, and the addition of 30 parts Venice turpentine, taking care to agitate the mass with a stick, so as to insure its homogeneity.

(9) Four parts glue melted with the least possible quantity of water, 1 part Venice turpentine will resist moisture.

(10) That solder in some form adheres to glass is well known and practised by the makers of fictitious jewelry. These are made up of pieces of black glass, cut and polished, and fairly soldered on to metal plates. By breaking one of these across it will at once be seen how strong the adherence really is. If the work has been well done the pieces of glass do not fly off, but are difficult to remove except in fragments. This soldering is done as follows: The shields, or metal plates, are coated with a thick layer of tin; these, together with the appropriate pieces of glass, are laid on an iron plate, heated to the melting point of the tin. The piece of hot glass to be soldered is then picked up with forceps and its edge introduced under the surface of the melted stratum of tin and slid forward so as to carry some of the metal before it, thus skimming off the oxidized surface so as to bring clean glass and clean metal in absolute contact. No glue must be used; the least trace of oil or resin will spoil the operation. When the piece of glass is fairly in place it is pressed down in order to squeeze out the surplus solder. It is this sliding action that insures success; if the glass were to be directly pressed down upon the tin solder no adhesion would take place at all from the presence of a trace of oxide and the existence of an air film. The glass, of course, must be polished and perfectly clean.

(11) Beeswax and Venetian turpentine in varying proportions, depending upon consistency desired.

Leather Preservatives.—One hundred parts *Sweet Oil,* 100 parts *Mutton Suet,* 2 parts *Turpentine.* Melt together and apply to the leather, which has been sufficiently warmed so that it will liquefy and absorb the fat. Another formula is as follows: 10 oz. *Linseed Oil,* 10 oz. *Mutton Fat,* 1 oz. *Venice Turpentine* melted together. Apply to the leather when dry and warm and it will preserve it against wet or snow.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

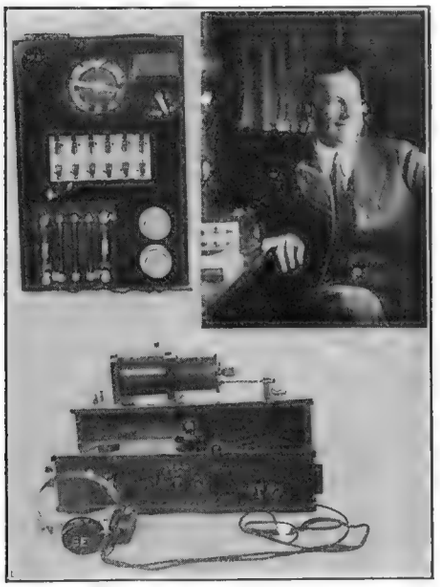
Monthly Prize, $3.00.

This month's prize winner.

THE HOPKINS RADIO STATION.

The accompanying views show the apparatus employed in my successful radio station. The receiving set is of the cabinet style, which consists of a loading coil, loose coupler, primary and secondary variable condensers, crystaloi detector, fixed condenser and a pair of 2,000-ohm 'phones. With this set I am able to hear nearly all the coast stations from (N. A. R.) Key West to (W. C. C.) South Wellfleet.

The transmitting set is of the rotary panel type, which is highly efficient owing to the very short connections. In the base is mounted a ½-K. W. closed core transformer, and above that is the adjustable condenser and rotary spark gap. At the rear of this is the oscillation transformer.



James R. Hopkins and Wireless Set Built by Himself.

The photo shows protective device, condenser and rotary controlling switches mounted on the fiber panel. I am able to communicate with amateurs and ships within a radius of 50 miles and more.

The aerial consists of two copper wires 82 feet long and 35 feet high.

JAMES R. HOPKINS.

Newport News, Va.

C. JAROSZEWICZ'S WIRELESS OUTFIT.

Herewith are photographs and description of my wireless set for the Amateur Wireless Station contest.

The aerial is 75 feet high and 80 feet long and is composed of six strands of No. 12 hard-drawn copper wire.

The set is all home-made with the exception of the receivers and spark coil.

My receiving set consists of 2,000 ohm Brandes' 'phones, loose coupler, two-slide tuner, loading coil, galena, silicon, ferron, carborundum, and copper-iron pyrites detectors, variable condenser and fixed con-

Fine Experimental Radio Station of Mr. Jaroszewicz.

denser. On favorable nights I can hear N.A.A. 10 feet from the 'phones, while W.G.O. can be heard 50 feet from the 'phones.

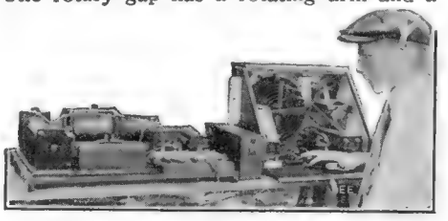
My transmitting set comprises a Mesco type, two-inch spark coil, spark gap, condenser, helix and key. For the source of current for operating the spark coil I use a dynamo which I have constructed with the help of my father. This dynamo while running at a speed of 2,800 r. p. m. generates 50 volts and 30 amperes. The armature of this dynamo is wound with insulated copper ribbon.

Chicago, Ill. CASIMIR JAROSZEWICZ.

UNIQUE RADIO OUTFIT OF FRANK SAHLMANN.

The following is an explanation of my little wireless set, a picture of which is herewith presented.

The set was all made by myself, with the exception of the jump spark coil and the step-down transformer. The key has large platinum points taken from an old spark coil vibrator. The oscillation transformer is made of brass ribbon which has been split and wound on cross arms in the shape observed. The sending condenser was constructed from an old glass tumbler with thin walls, coated inside and outside with tinfoil. The spark gap was made from an old telephone lightning arrester. The rotary gap has a rotating arm and a



Frank Sahlmann's Radio Apparatus.

stationary disk, which renders the gap easier started and stopped and also reduces the vibration. The small rheostat shown is used to regulate the current feeding the coil and is made up of old screen wire.

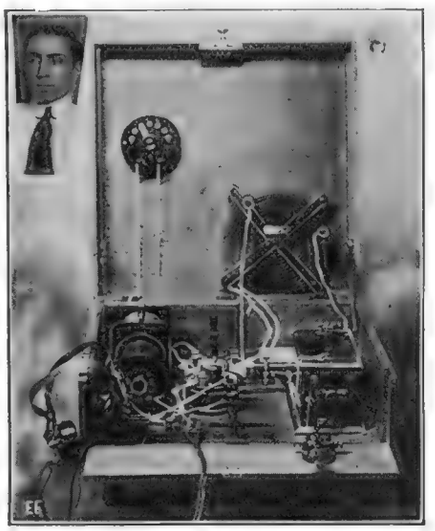
In the receiving set the fixed-adjustable condenser is made up of eight small units, containing from two to 16 sheets of tinfoil each and so connected that from two to 30 sheets may be used at one time. The wire used on the loading coil and the tuning transformer was obtained from the regulating coil of an old arc lamp. The bell and the battery are used for testing purposes. I have made a cover for the receiving set which is not shown. It will be noticed that the set is very compact and thus easily carried from place to place.

Salina, Kan. FRANK SAHLMANN.

D. J. CYR'S WIRELESS STATION.

The accompanying illustration is that of a portable wireless outfit mounted in a specially designed, quarter-sawed oak case made by the owner.

The outfit consists of, from left to right: a loose coupler, a fixed condenser is placed alongside of it; a 23-plate variable con-



Portable Radio Set of Darrel J. Cyr.

denser, a three-cup detector (the bracket being on a rod so as to slide to the different minerals, which are galena, silicon and molybdenite), spark gap, 1-inch spark coil and a moulded sending condenser back of it. The key is on the hinged front and the helix is fastened on the cover. The switch is seen in the rear center. One 1,000-ohm headset is shown in the picture, but will be replaced by 3,000-ohm 'phones. A 5,000-meter loading coil has been placed in the cabinet.

My aerial consists of six wires, spaced 18 inches apart, in the shape of a "V." It is hung on 18-foot poles on top of a house 35 feet high. I can get NAA, WSL and other stations.

I am a member of the Central Radio Association and the National Amateur Wireless Association.

Sioux City, Iowa. DARREL J. CYR.

JOEL YOUNG'S WIRELESS STATION.

My set consists of two receiving outfits—one containing a loose coupler, an audion detector and a mineral detector, one variable condenser, one pair of Murdock receivers of 2,000 ohms resistance; while the other is a new set. This consists of a tuner, one variable condenser and one pair of Murdock 'phones. The outfit is capable of

Joel Young's Radio Station.

receiving Sayville and other undamped wave stations. I have the audion arranged with a double-pole, double-throw switch, so that I may use it on either set. The audion terminals for the tuner go to the main poles of the switch and the secondaries of the other to the other end of the switch. The aerial and ground switches are worked in the same way.

I can hear Arlington on both sets of instruments very loudly. I also hear amateur stations, and commercial ship and coast stations.

My sending set consists of a Blitzen one-quarter kilowatt transformer, a rotary spark gap of my own construction, besides a helix and condenser, both made by myself.

The sending outfit is controlled by a switchboard, which may be seen in the picture.

The sending apparatus is in a small building located about 60 feet from the house. The receiving outfit is in my room. Thus I operate the sending set at a distance of 60 feet, after the fashion of the large commercial stations.

My aerials are as follows: One has four wires, space1 2¾ feet apart, and is 30 feet high and 100 feet long. The other is 500 feet long, 35 feet high and contains but one wire. The material used is galvanized iron wire. The former is used for sending, and both are used for receiving. My official call is 8 ALK. JOEL YOUNG.

Elmira, N. Y.

RADIO STATION OF E. L. NORTON.

My radio transmitter consists of an .8-K. W. 10,000-volt transformer, rotary gap giving about 900 sparks per second, a condenser of .0085 mfd. capacity, an oscillation transformer and aerial loading inductance. The set is licensed to use all waves up to and including 600 meters. It has a normal night range of about 250 miles, but has been heard at a distance of over 500 miles *over land.*

The receptor is connected on the Armstrong oscillating audion system. With proper primary loading coils it will tune to 12,000 meters. The switches on the front of the cabinet from left to right are: Primary and secondary of large tuner, four switches for controlling the large coils used in the Armstrong system, the audion bulb, the high voltage battery switch, a telephone switch for lighting the audion bulb, changing over to the crystal detector if desired, or for shorting the latter while sending, and at the right a "Blitzen" tuner for short waves.

Excellent Wireless Installation of E. L. Norton, at Rockland, Me. Has Been Heard Over 500 Miles.

Two aerials are used, one for transmitting and for receiving on all short waves, which consists of six copper wires, 60 feet high and 76 feet long, and a single wire 325 feet long for all long waves.

EDWARD L. NORTON.

Rockland, Me.

Amateur News

Institute of Radio Engineers' December Meeting.

The December meeting of the Institute was held Wednesday evening, Dec. 1 in Fayerweather Hall, Columbia University, New York.

Two papers on "Capacities" and "Radio Transmission Phenomena" were presented by Fritz Lowenstein.

The first of these papers dealt with a number of interesting points in connection with the field energy of capacities and endeavored to correct certain common errors in connection therewith.

The second paper considered the phenomena of radiation from normal antennae and contrasted critically the explanation of these phenomena given by Tesla, with those at present in vogue. Highly novel and suggestive explanations of radio transmission were given.

Talo Club of New York City.

The Technical Association of Licensed Operators or Talo Club was formed on Oct. 21, 1913, with the purpose of gaining further knowledge of wireless by combining serious work with theoretical argument.

Meetings are held fortnightly at which papers are presented and discussed. The present membership is: W. Woodrow, president; E. T. Dickey, secretary and treasurer; W. J. Howell, past-president; W. H. Sands, F. L. McLaughlin, R. B. Austrian, S. A. Murray and M. W. Sterns. Address all communications to the secretary's office, 1649 Amsterdam Ave., New York City.

The Yorkville, N. Y., Radio Development Association.

Recently a radio club was organized by several amateurs and scientists who had "fallen" for the "tick-tick." An election was held and Mr. Joseph L. Cermak, was elected president. A very able vice-president was found in the person of Dr. Frank G. Josephs of New York City, also. The club was organized for the purpose of bringing to a higher state of perfection the telephonological radiocommunicative apparatus of the present time, and, according to the latest reports, everything is going along smoothly. Mr. Cermak, who is a hopeless "radio-bug," has contributed largely to the wireless field. An interesting series of wireless lectures were once given by him in Public School No. 168, Manhattan. The members at present consist of his able assistant, Frederick ("Sulphate") Smith, G. Engler, E.E., M.A.; Geo. Barry, Charles Lucek, Frank Bartinek and the honorable scribe, H. Gutman. All communications should be sent to Jos. L. Cermak, E.E., 73 East End Ave., New York, and a good-natured answer will be received by the next mail. Get busy, fellow "bugs."

New California Radio Club, at Redlands.

The amateurs of Redlands, Cal., have recently organized a radio club. The name of the club is "The Radio Club of Redlands." The officers of the club are Ezra Moore, president; Arthur Munzie, vice-president; Rudolph Kubias, secretary-treasurer; Harry Williamson, assistant secretary-treasurer. The other members of the club are Howard Hamilton, Donald Anderson, Ernest Tubbs, Charles Dewith, Norman Peiffer, Dean Fowler and Phillip Murkett. We would be glad to communicate with other radio clubs. Address Rudolph Kubias, No. 457 Alta St., Redlands, Cal.

Radio Club of America October Meeting.

The October meeting of the Radio Club of America was held on Saturday evening, Oct. 9, in Room 304, Fayerweather Hall, Columbia University, New York City.

Mr. Fritz Lowenstein presented a paper on "Quenched Spark Sets." Mr. Lowenstein, who is well-known as a pioneer in this field of apparatus development, described in detail the principles, design and operation of sets of this type, discussing critically many recent developments in the general theory of transmission as applied to quenched spark apparatus.

John L. Hogan, Jr., Emil J. Simon, M. E. Packman and G. J. Eltz were the chief participants in the discussion.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

East Night High School Radio Society.

On the evening of Oct. 7, the students of the East Night High School of Cincinnati O., interested in the radio art were organized by Mr. Wm. G. Finch and Mr. C. H. Fender, pioneer radio men. The organization was named the East Night High School Radio Society, whose objects are as follows: 1—Advancement and development of the "Radio Art"; 2—To prepare the members to qualify for U. S. Government commercial operator's license; 3—To be able to render effective assistance during times of emergency; 4—To promote radio intercourse among other institutions of learning in the United States.

The following officers were elected: President, Wm. G. Finch; Secretary, C. H. Fender; Treasurer, Professor Frantz.

The society at present has a membership of fifty-two. The society will install a 5 K.W. transmitting set of the most modern type; the receiving set to be the last word in radio engineering. The organization extends an invitation to all other institutions of learning which are in sympathy with their movement to effect a "relay association" among them. Those who are interested in the above movement please communicate with C. H. Fender, secretary, East Night High School Radio Society, Cincinnati, Ohio.

The Junior American Guard.

Boys are wanted to join the Junior American Guard, a juvenile national guard, whose object is to instil into boys the proper regard for discipline, obedience and military instruction.

Among the activities to be carried on are military instruction and engineering, first aid, signaling, wireless telegraphy, marksmanship and drum, fife and bugle instruction.

Since its organization last May, its membership has reached 3,000. At the head of the organization is Brig.-Gen. Andrew C. Zabriskie, a 7th Regiment veteran, and former member of the Governor's staff, and who for many years has been connected with boys' activities.

Second in command is Maj. William H. Elliott, formerly with the Boy Scouts. Headquarters have been established at No. 52 Beaver St., New York City.

Chas. F. White, 117 East 127th St., New York City, wishes to hear from boys between 12 and 18 years of age, especially those interested in wireless telegraphy, for the purpose of organizing a radio and signal corps.

Information will be gladly furnished to anyone over this age who desires to organize in or outside of New York City.

LATEST PATENTS

Focusing Lamp Socket.

(No. 1,153,591; issued to William F. Anklam.)

This lamp socket is intended for

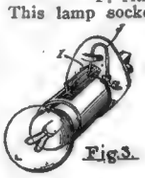


Fig.3.

Fig.4.

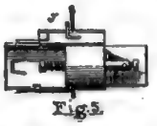


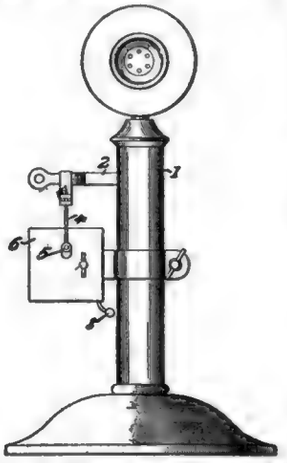
Fig.5.

automobile head lamps where it is desirable and in many cases imperative, that the electric lamp itself shall be properly focused. The socket in this case is held in any required position by means of a flange, rack I and spring wire catch J, engaging same at any desired point to which it may be set.

Telephone Fire Alarm Attachment.

(No. 1,155,722; issued to Felix Gottschalk.)

In this telephone fire alarm de-

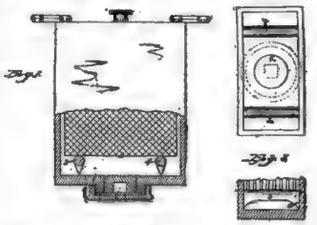


vice, use is made of a fusible link which in case of fire, melts, thus releasing the switch hook 2, and also the trigger 5, of a clockwork actuated mechanism 6, containing a tapper 8. This strikes repeatedly by code signals or otherwise, against the metallic upright column of the telephone stand 1. These tapping sounds are heard at the central office exchange and it is then known exactly from what source the alarm emanates. This device here shown is for telephones other than the common battery type.

Easily Cleaned Storage Cell.

(No. 1,154,372; issued to Augustus P. Burritt.)

An improved storage cell jar is

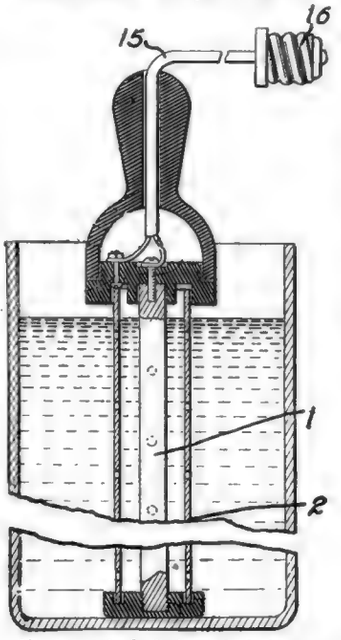


offered in this design, which provides at the bottom of same a large orifice with threaded cap, which may be opened periodically to facilitate the flushing out of the sediment, etc., from the cell. The plates are supported on the arched ribs 3 and 4, thus permitting of the solution or flushing water passing readily through them, without impeding the discharge of the sediment, etc., in this action.

Electric Water-Purifier.

(No. 1,159,699; issued to James A. Murdock, assignor of 7/16ths to John H. Hirst, and 9/16ds to Cecile A. Murdock.)

This scheme for purifying water

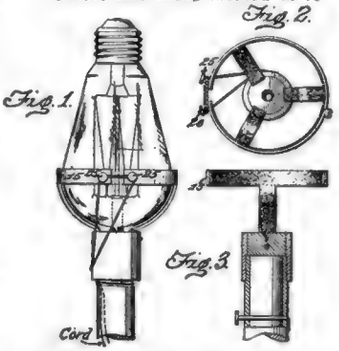


by the action of electrolysis is made possible by passing ordinary lighting current into a cell containing the liquid as shown in the illustration. The electrodes 1 and 2 are connected to opposite sides of the circuit through the medium of a flexible conductor and plug 15 and 16. The tubular electrode 2 is perforated, to enhance the circulation of the liquid.

Electric Globe Replacer.

(No. 1,157,617; issued to Elwood H. Conrad.)

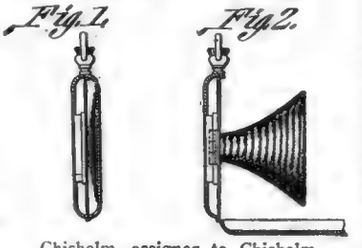
A simple and cheap method of re-



placing electric bulbs is outlined in this patent, which should find a wide sale indeed, as the attachment may be sold at a low price, and utilized with an ordinary length of pipe. It incorporates primarily a felt-lined ring 15. This ring is split as indicated and over the two buttons 25 and 26 a cord is passed, so that when a bulb is placed in a socket, the cord through the re-lamper handle is pulled taut; thereby causing the ring 16 to contract and grip the globe tightly.

Individual Telephone Mouth-Piece.

(No. 1,158,686; issued to Chas. L.



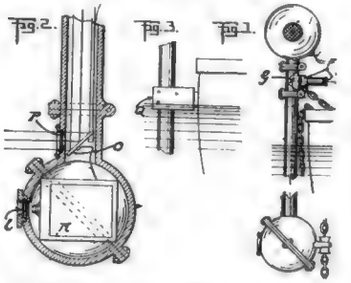
Chisholm, assignor to Chisholm Transmitter & Telephone Instruments Company.)

The patentee of this invention claims to provide a satisfactory and convenient form of collapsible and sanitary microphone mouth-piece for telephone systems. Great stress is laid on the unsanitary aspects of the common telephone mouth-piece and he here provides one which may be carried by every individual in the same way as a watch. The mouth-piece is collapsible and comprises a spiral wire form, supporting (when extended) a flexible covering material, such as soft rubber or oiled silk, etc.

Device for Under-Water Exploration.

(No. 1,156,782; issued to Charles Francis Jenkins.)

This device comprises a telescopic tube as illustrated, fitted with two chambers, at top and bottom. The



submerged, lower chamber contains a motion picture camera, electrically controlled by means of a wire passing down through the tube from the deck of a vessel or float. A powerful light is enclosed in the upper shell and is projected downward through the tubes, being reflected from a mirror O, through a window P. Pictures are taken by the camera M, through the window L. The submarine landscape may be viewed through a telescope F, by means of a small reflecting mirror G placed in focus of mirror O.

Improved Storage Battery.

(No. 1,159,021; issued to Harry S. Hawkins, Abbott M. Green and Isaac W. Gibbins.)

Fig.2.

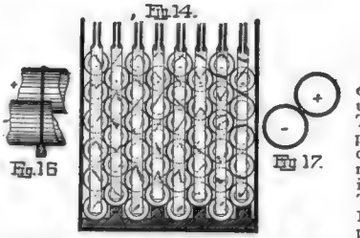


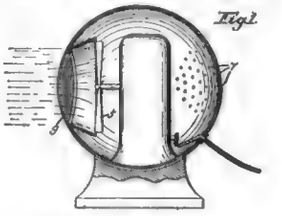
Fig.16 Fig.17.

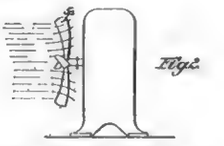
The inventors of this novel storage battery, which seems to possess considerable merit, have designed the positive and negative electrode or plates of a number of cylindrical rods. As may be seen from the illustration each of these rods is made up of alternate discs on a central, lead alloy bar. Every other disc is composed of an active material, which is oxide of lead, and the intermediate discs are made of a porous material, such as volcanic scoria. Around each compound cylinder thus constructed there is placed a foraminous sleeve, of lead alloy for instance, which is also perforated.

Electric Fan Motor.

(No. 1,156,901; issued to Chester I. Hall, assignor to Chicago Electric Meter Co.)

This is another form of electric



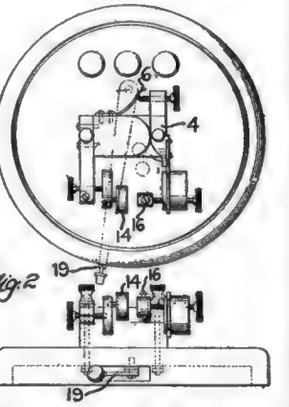


fan motor and is intended to be mounted with motor complete inside of a metal or other shell, as seen in illustration. This shell, at the rear of the fan, is perforated with numerous holes through which the air is drawn and the fan blade projects a draft of air through a screen 9; the mesh of which is not so fine as to impede the propagation of the air. The patentee also claims that by special construction of the blade 5, Fig. 1, and also at 5a, Fig. 2, particularly, that a practically parallel stream of air can be projected or produced.

Radio Detector.

(No. 1,159,969; issued to Charles O. Lorenz.)

This radio detector involves sev-



eral unique features and is to be used with minerals such as Perikon. The support 16 is mounted on a pivoted arm 4, resiliently by virtue of the spring 6. Hence the adjustments of the mineral cup 16 are made independent of the spring tension. The second mineral cup is shown at 14. A short-circuiting switch 19 is provided for protecting the detector while transmitting.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

$$\#\left(\frac{X^2}{4}=47\right)$$
$$X\ \overline{(9+F^4)\times B}$$

I. M. STEWED, PUSSYCATNIPSTOWN, HAR.

FELINEOLA

Patent Specifications Filed, Sandpapered and Polished

To Sufferers Throughout the Land:

Let it be known that I, I. M. Stewed, of Pussycatnipstown, in the State of Harmony, have perfected certain necessary and useful improvements on nature. By means of my Cat-Organ or Felineola it is possible to transform a town infected with nerve-racking nocturnal noises into a burg of melody. All this to be accomplished by the proper grouping and controlling of those aforesaid sleep disturbers into a whole harmonious unit capable of rendering orchestral pieces with a purity of note found in none of our so-called modern instruments of the musician's art.

It consists primarily of a series of sound-proof receptacles, the openings of which are controlled by a keyboard. In each and every compartment is placed a cat as per specifications attached. The plan proposed also provides that each family in the neighborhood should dedicate a cat. They are graded according to the pitch of their voices (which does not correspond to their colors) and placed in the proper compartment.

Each box has a sound-proof door hinged at the top with an iron armature, attached so that the magnets on top will open the doors when energized.

The magnets are connected to electrical contacts, which are controlled by a regular player-piano roll driven by a motor.

The effect of this arrangement is the production of harmony that "hath powers to soothe the savage breast," and the screams of the felines will, to such craft as cruise in the neighborhood whose minds are distorted from the fumes of their alcohol burning furnaces, sound like the war cry of His Satanic Majesty, and they will at once deny all further allegiance to King Barleycorn. Thus not only will the citizens' tempers be saved but many erring souls will be saved from a life of degradation.

When the populace tires of this amusement, probably about 1.30 a. m., the Mayor has merely to close the switch and the bottom will drop out of the boxes and allow the cats to fall on the charged wires. They will disperse with one grand finale.

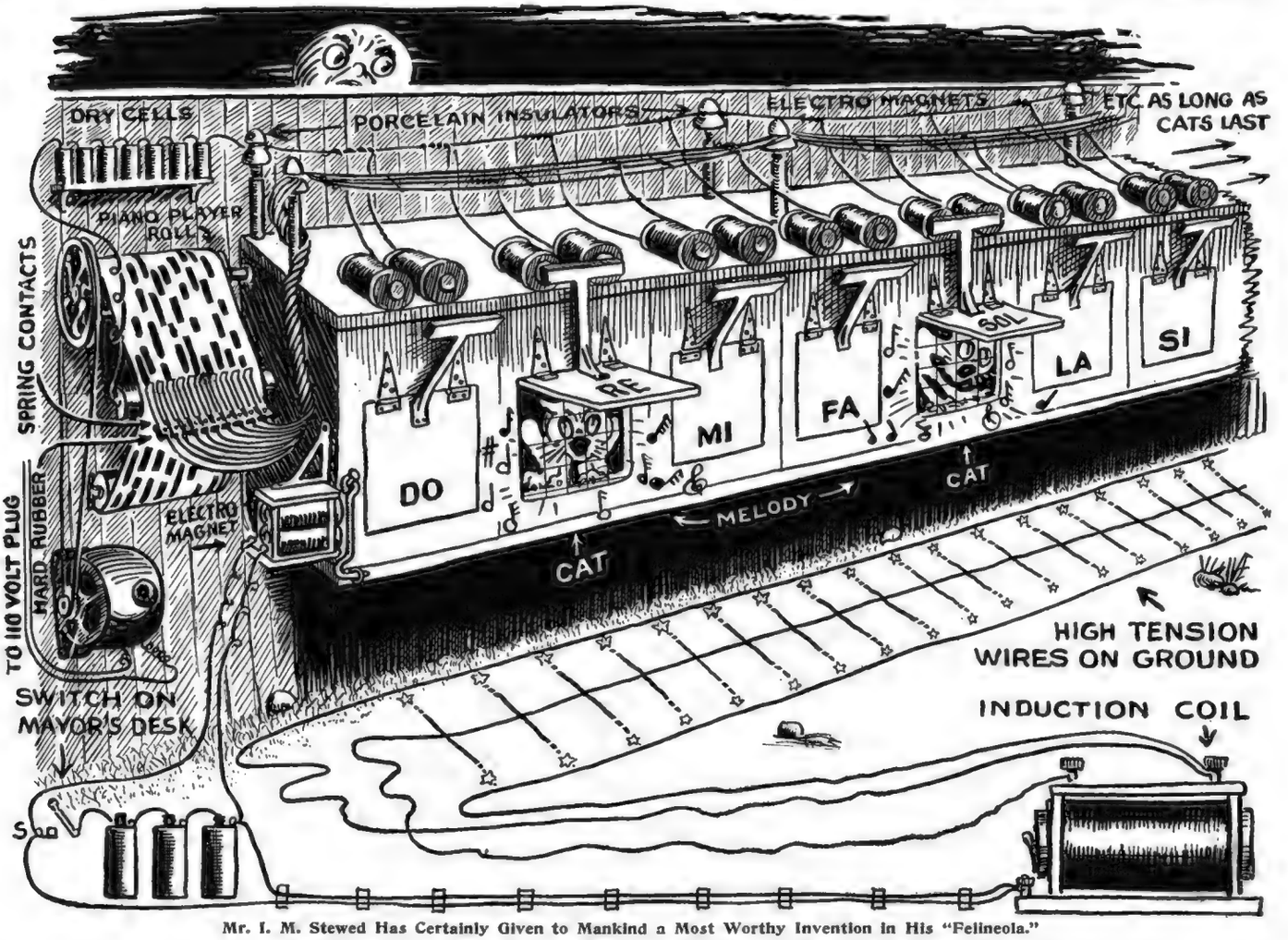
A method is also covered by my invention for recovering the cats for the next entertainment. The cats are, each and every mother's son of them, and daughter, too, fed with mush containing iron filings; after nine feedings they will become highly magnetic. Large electro-magnets mounted on the municipal fire truck will pick up the felines from the highways and low-ways to hold the concert.

This metallic treatment will also give their voices a slight metallic ring that will make their serenade sound not unlike distant church bells on a Sunday morn.

In testimony thereof, I hereunto attach my seal as indication that this idea is approved by the S. P. C. A., for the cats will be no longer picked on or at by sundry bricks, books or alarm clocks.

I. M. STEWED,
Pussycatnipstown, Har.
By his attorney, R. L. Kunan,
Sabula, Iowa.

Witnesses:
WATT A. SIMP,
HOPE U. CHOKE,
TOM KATT.



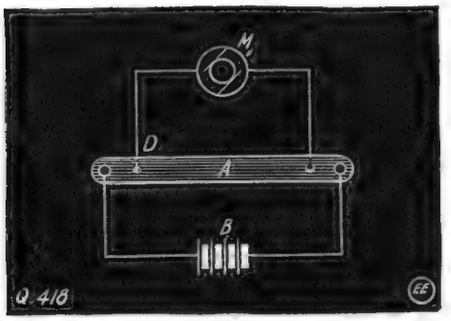
Mr. I. M. Stewed Has Certainly Given to Mankind a Most Worthy Invention in His "Felineola."

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

OHM'S LAW.

(418.) John T. Dwyer, West Philadelphia, Pa., sends us a drawing which is reproduced herewith and wishes to know if current can be drawn from points such as D on the bar A?



Operating Motor in Shunt to Bar Carrying Current.

A. Current may be drawn from the points mentioned, provided the resistance of the bar A between such points as D is equal to or greater than the resistance of the circuit through the motor M. The current flowing through this shunt circuit will depend on the ratio of these resistances.

AMPLIFYING HOOK-UP FOR DETECTORS.

(419.) C. R. White, Brooklyn, N. Y., writes us, asking for a method enabling him to use an audion to amplify from a Perikon detector.

A. We refer you to query No. 410, January, 1916, issue; this hook-up can be used with your instruments.

REGARDING SELENIUM.

(420.) Albert Walker, Erie, Pa., writes us for the address of a concern supplying selenium.

A. This peculiar material is handled by several concerns throughout the United States. The Electro Importing Co., 233 Fulton street, New York City, can supply you with this element in any quantity desired at a nominal price.

CALCULATING AREA OF CONDENSERS.

(421.) David Causey, Greenville, Ill., desires: 1. The formula for calculating the area of tinfoil and glass plates, used in the construction of a condenser for any given capacity. 2. The usual voltage and amperage of three-bar telephone magneto.

A. 1. The formula appended will enable you to calculate the area of the active dielectric necessary for any given capacity:

$$A = \frac{36 \pi d \times C \times 10^{6}}{K}.$$

In this formula d is the thickness of the dielectric in cms., C the capacity of the required condenser in M.F. The dielectric constant K can be obtained from any textbook on the subject, and the answer will be the area of the active dielectric in sq. cms. (also pi = 3.1416). The total area may be made up of any number of plates, but for high tension condenser construction the plates are usually 10x12 inches, while in small, low tension condensers the tinfoil strips are usually three inches wide, and the paraffine strips are four inches wide.

A. 2. The regular three-bar telephone magneto delivers about 75 volts and one-quarter ampere, alternating current.

LOADING COILS.

(422.) Grant Merrill, Redwood City, Cal., writes for information on the size of wire used in constructing tuning coils and the best method of making same, whether to wind the coil in a single layer or to wind it in many layers?

A. Loading coils as well as tuning coils can very well be wound with No. 24 to No. 26 magnet wire. The best way of making your loading coil is to wind it on a long cardboard tube in a single layer. Any kind of insulated wire may be used. The wave length is correctly figured by noting the inductance of the coil, which will have to be calculated from some one of the various formulas given in text-books. A simple rule for calculating the wave length of any tuning coil or loading coil is to multiply the length of wire in feet on the coil by 1.5, which will give approximately the wave length in meters.

STORAGE BATTERIES.

(423.) John B. Moore, Buffalo, N. Y., asks us several questions: 1. The current given by two 6-60 storage batteries when connected in series and in multiple? 2. A short method for figuring the wave length of loose couplers? 3. If a suitable form of acid rectifier would work in place of the crystal rectifier employed in wireless telegraphy for detecting the small currents in the receiving set?

A. 1. When two 6-60 storage batteries are connected in series the current obtained will have a voltage of 12 and the batteries will give 6 amperes for 10 hours, but when the storage batteries are connected in multiple the voltage will be 6 or equal to that of one battery, while the current output will be twice as great as from a single battery or 120 A. H.

A. 2. A rough method of calculating the wave length in meters of loose couplers is to multiply the length of the wire in feet on the primary only by 1.5.

A. 3. The ordinary electrolytic detector is nothing more or less than an acid rectifier, for when the current flows in one direction it breaks down the film of hydrogen gas formed on the platinum point and when it starts to flow in the other direction the hydrogen gas is formed around the platinum point, which action is a check on the flow of the current.

INCREASING RECEIVING RANGE.

(424.) Russell Holcomb, Ottumwa, Iowa, writes us asking: 1. When an aerial is located between two hills what is the best method of increasing the receiving efficiency? 2. Are there any commercial or Government stations in Iowa?

A. 1. When an aerial is located between two hills the best method of increasing the receiving range would be to run a long single wire from one hill to the other with a lead-in from the center.

A. 2. There are no commercial or Government stations in Iowa, but several colleges have installed powerful radio transmitting apparatus, particularly the Iowa State College at Ames. This college makes a practise of sending the weather reports to the amateurs located in the State at noon. It is favorably placed for this purpose, being practically in the center of the State.

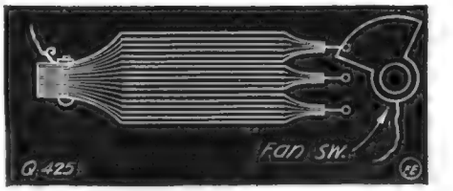
CONDENSER HOOK-UP.

(425.) Kilian Banfelder, Brooklyn, N. Y., desires to know: 1. If the connections for the condenser as shown in his letter are correct? 2. The wave length of a coil 3 inches in diameter and 14 inches long? 3. What high powered station he can receive with his apparatus?

A. 1. The connections shown may be used for controlling a fixed variable condenser, but, contrary to the general rule, the capacity will get smaller instead of larger as more condensers are thrown into circuit. We therefore suggest the use of the hook-up as shown in the accompanying illustration for controlling a number of small fixed condensers.

A. 2. The coil has a wave length of about 900 meters.

A. 3. With your apparatus you should have no trouble in receiving the high powered stations located around New York. You should hear Sayville, Arlington, the



Utilizing Fan Switch for Connecting Condenser Units.

Brooklyn Navy Yard and commercial stations within a range of 200 miles.

AERIAL MASTS.

(426.) T. Weston Howard, Dexter, Me., desires to know if the iron masts used for constructing aerials should be insulated from the earth or grounded.

A. Some iron masts for aerial work are insulated from the earth or ground and others are not. The 800-foot mast at Tuckerton, N. J., is a part of the aerial and it rests on massive glass insulators at the base.

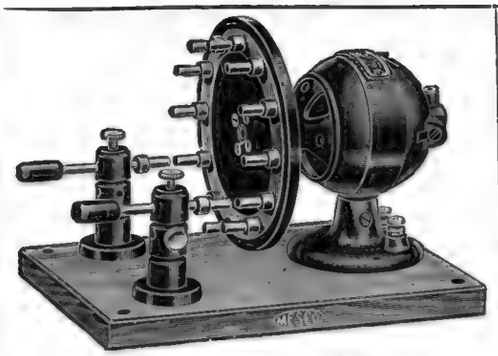
TESLA TRANSFORMER FOR WIRELESS SET.

(427.) A. E. O'Brien, Jr., New York City, wishes to know: 1. Whether a Tesla transformer will improve the sending range of the wireless set. 2. How to receive undamped wave stations with an ordinary receiving set? 3. Why he cannot receive a station using a 1¼-inch spark

(*Continued on page* 578.)

"QUALITY" is our Wireless Watchword

SATISFACTION GUARANTEED OR MONEY REFUNDED OUR MOTTO



Mesco Rotary Spark Gap

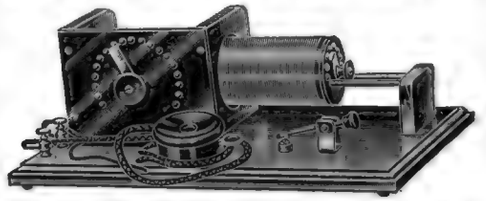
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes, 1 3/16 in. shaft	5.00

Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	Manhattan Wireless Receiving Set	$10.00

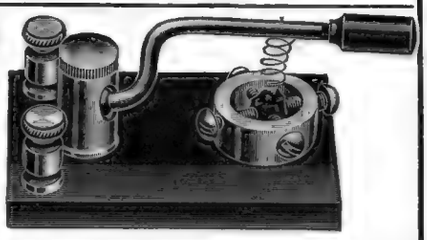
Mesco Intensifying Transformer

Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

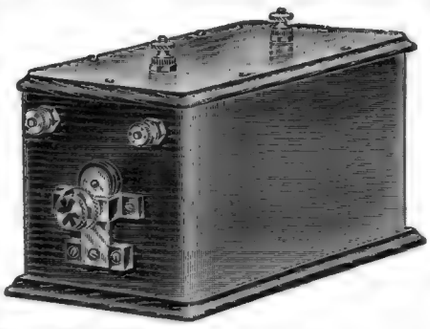
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

Get the Best 10c. Value You Will Ever Buy

SEND FOR OUR POCKET CATALOG, W 28

It contains 248 pages, 1,100 illustrations and costs you nothing.

IT MEANS MONEY SAVED TO YOU

to have our Manual and our Catalog when you want to buy.

Mesco Codegraph

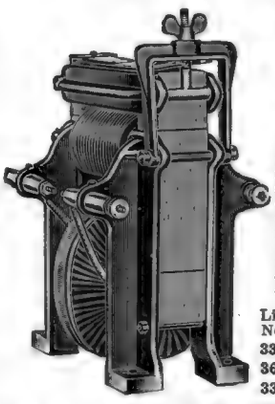
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	Mesco Codegraph Set	$2.50
304	Codegraph Plate, Pen and Book	1.00

MANHATTAN ELECTRICAL SUPPLY CO.

New York, 17 Park Place. Chicago, 114 S. 5th Ave. St. Louis, 1106 Pine St.
San Francisco Office, 604 Mission St.



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Price.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

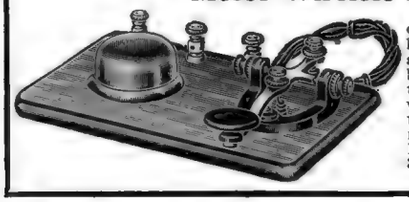
Mesco Wireless Receivers

Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 1000 ohms each	$6.00

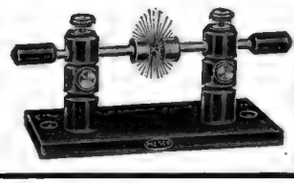
Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.50

Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$3.00

YOUR RANGE
DEPENDS ON YOUR
RECEIVERS

Holtzer-Cabot
Radio Receivers
have honestly earned their reputation of being the

"Most Sensitive Receivers Made"

Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.

THE HOLTZER-CABOT ELECTRIC CO.
BOSTON — CHICAGO

UNMOUNTED TRANSFORMER

You Can Get Results with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of he work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio

100 PERSONAL OR PROFESSIONAL CARDS
Leather Card Case FREE with each order. Write for samples and Type List.
ELITE CARD PRINT CO.
Station M Jackson, Mich.
50c

QUESTION BOX.

(*Continued from page 576.*)

coil located 6 miles away when he can get Arlington during the day?

A. 1. The Tesla transformer of the regular type will be of practically no use in a wireless station and an oscillation transformer is not advised except with powers of ¼ K. W. or more.

A. 2. You may receive undamped wave stations with an ordinary wireless set by connecting the tikker in series with the secondary circuit. The tikker can be built according to instructions that have appeared from time to time in this journal.

A. 3. The 1½-inch spark coil set which will not send signals 6 miles is, no doubt, poorly tuned for the best results. It is necessary to tune the set carefully and to get the closed and open oscillating circuits in resonance before the maximum range can be covered.

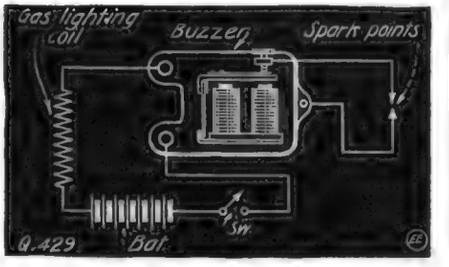
DYNAMO PLANT.

(428.) Oscar Stulman, Baltimore, Md., wishes to know if it is practical to drive a 24-watt dynamo with an ordinary sewing machine by connecting the pulley and treadle of same with the dynamo by means of a belt?

A. The small dynamo can be attached to a plain sewing machine by the regular belt and you can drive it up to full power by means of the treadle. It will light from 8 to 10 6-volt Tungsten lights, depending on the candlepower of same, which should not be over 1 candlepower each. With this arrangement you can also charge storage batteries, although the process is very slow.

JUMP SPARK FROM BUZZER.

(429.) Sigmund Senz, Bronx, N. Y., wishes to know: 1. How to obtain a jump



Jump Spark Produced from Buzzer.

spark from a buzzer? 2. If an ordinary alternating current magneto may be used for ringing an electric doorbell?

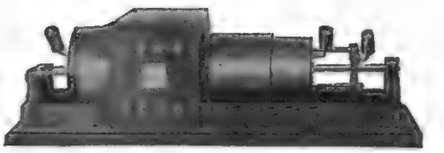
A. 1. You can obtain a minute jump spark from a buzzer by using the connections shown herewith. For best results it is necessary to use quite a number of batteries on the buzzer and to have a rather long throw on the armature. The spark will not be more than 1-16 inch at the most, and this method is a very poor manner for obtaining a jump spark.

A. 2. You may ring a polarized bell with an alternating current magneto very easily, but we doubt if this machine will deliver enough current to ring an ordinary electro-magnetic bell.

GAS FOR BALLOONS.

(430.) Claude Martin, Brownwood, Tex., wishes to know what chemicals will generate a powerful lifting gas that would be safe and non-explosive and the type of generator required.

A. The gases used for inflating balloons is hydrogen gas or illuminating gas. The former is obtained by dissolving scrap zinc in a 4 to 1 solution of sulphuric acid, and the latter is purchased from a local gas plant. We know of no gas with any power-



Type AML—Patent Pending

The Precision Varicoupler

is perfection in receiving tuners. It gives you absolute precision in tuning. It has

No Taps	No Sliders
No Switches	No Delicate Parts
No "Dead Ends"	All the Wire in
No Contacts	Use all the Time

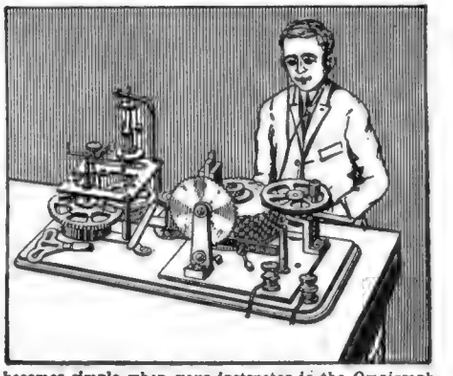
and is of up-to-date design.

Type AML - Price, $25.00
Type AMS - Price, $17.50

For detailed information write for circular P1

The Precision Radio Equipment Co., Inc.
General Office: 868 Putnam Ave., Brooklyn, N. Y.

LEARNING TELEGRAPHY



becomes simple when your instructor is the Omnigraph Automatic Transmitter. Combined with a standard key and sounder or Wireless Busser, it will send you telegraph messages at a slow speed, which can be increased at will to match the sending of an expert operator as you become more proficient. Adopted by U. S. Gov't. Made in 4 styles, from $2.50 up, all accurate. Circular free.

Omnigraph Mfg. Co., 39 L Cortlandt St., New York

$8.50 Guaranteed Amplifier Coils $8.50

TRANSFORMERS

Built for Wireless

The Pittsburgh Wireless Equipment Co.

are under new management at

RIDGWAY, PENNSYLVANIA

and are on DECK to give you a SQUARE DEAL and 100% value in our

Superior Radio Apparatus

for every dollar's worth purchased

Send 10c. for our complete catalog. Parts catalog free.

PITTSBURGH WIRELESS EQUIPMENT CO.
RIDGWAY, PENNSYLVANIA

ful lifting properties that is not explosive and they are all more or less dangerous.

60 CYCLE TRANSFORMER ON 25 CYCLE CURRENT.

(431.) Clayton B. Shelley, Barker, N. Y., wishes to know: 1. If it is possible to operate a 60-cycle transformer on a 25-cycle circuit? 2. Why it is that when N. A. A. is sending on low wave lengths the signals die out, but when he moves the secondary of the coupler in and then draws it out to its original position the signals become strong again?

A. 1. A 60-cycle transformer may be operated on a 25-cycle circuit by using a resistance or a choke coil in series with it. The output of the apparatus will not be up to the full rating of the transformer.

A. 2. It appears to us that the rods on which the secondary slides are corroded and the spring makes poor contact with them. When the secondary is sli l along the rod it has the effect of scraping the rod clean and the contact is much improved. This may account for the signals coming in strong again.

SAL-AMMONIAC CELLS.

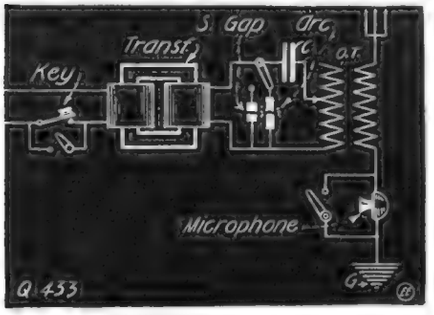
(432.) D. W. Fleming, Ottawa, Kan., asks: 1. If the carbon in the sal-ammoniac cells requires renewing from time to time? 2. If such cells may be used for lighting small lamps?

A. 1. The carbon in the sal-ammoniac cells does not need renewing, but it may occasionally be necessary to put the carbon in boiling water to drive out the salts that settle in the pores.

A. 2. These batteries may be used for lighting small lamps for 2 or 3 minutes at a time, but their amperage soon drops off, due to the polarizing of the carbon.

WIRELESS TELEPHONE SET.

(433.) J. B. Starkweather, Newtonville, Mass., desires to use a ¼-K. W. Clapp Eastham transformer in a wireless set and



Using A. C. Radio Transformer for Telegraphic or Telephonic Transmission.

in a combination wireless telephone and telegraph set, the supply current being alternating current.

A. We append a diagram of connections which will enable you to use the apparatus as either a wireless telephone or telegraph. As will be seen, a spark gap and arc may be thrown across the secondary terminals of the transformer as desired. The arc used may be of the regular carbon type or one utilizing carbon and copper rods and built according to the usual practice in wireless telephony. Although the 60-cycle alternating current supply will cause more or less of a hiss the outfit will work satisfactorily for distances of 5 miles. It is preferable to use an oscillation transformer, and the microphone transmitter is connected in the ground lead, while the key, which may be short-circuited by a switch when the outfit to be used as a wireless telephone, normally operates the set.

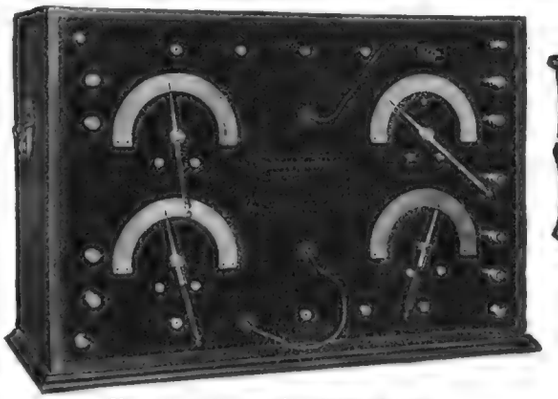
Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

We Guarantee Everything We Make! We Guarantee Everything We Say!

Everything We Make Is the Standard

UN-DAMPED-WAVER
(Will get Nauen, Hanover, Arlington, Sayville, Honolulu.)

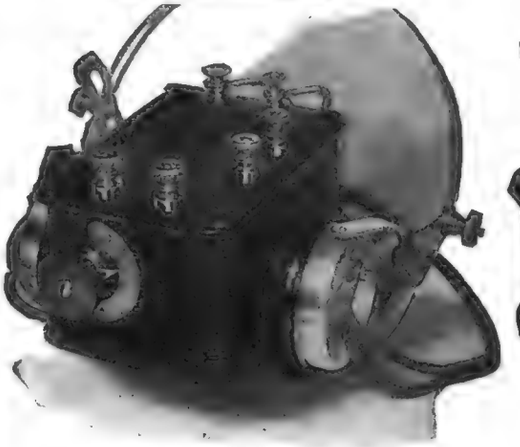


Size 24" x 16" x 10½". **Price, $100.**

TALKING MULTI-AUDI-FONE
(Will shout Washington time for you.)

With our specially wound Head Set and specially designed Horn.
Size 8¼" x 6½" x 5¼". **Price, $75.**

MULTI-AUDI-FONE



With our specially wound Head Set.
Size 4¼" x 3" x 2½". **Price, $30.**

TELEPHONE VOICE MULTIPLIER

(Will increase voice 40 times.)
Size 4¼" x 3" x 2½". **Price, $15.**

Every one of these instruments is *one hundred fold better than any other instrument of its kind.*

If you don't believe it—try them.

If after a ten days' trial you are not surprised and more than satisfied—we will return your money.

Will any one else do this? **Tear this out and ask for information about the instrument that interests you by writing its name here_____**

Send for circular to-day
Ask your dealer to-morrow
MULTI-AUDI-FONE
273 Morris Ave
ELIZABETH, N. J.

Chicago Wireless Headquarters

CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.

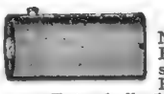
ROTARY VARIABLE CONDENSERS

Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75

No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....65c.
Extra battery....20c. Extra bulb....15c.

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....85c. 100 Watt.....90c.



No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....45c.
Extra bulb, 15c. Extra battery, 20c.

FINE 50c. POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for 25c.), or each 15c. New Flints, 5c. 6 for 25c.

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

LA SALLE LIGHT COMPANY, 134-136 N. La Salle St., Chicago, Ill., Opposite City Hall

NEW WIRELESS WONDER

THE INSTANT RADIOGRAPH

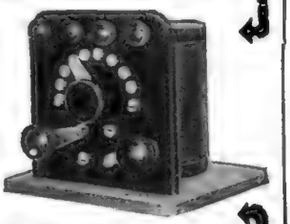
Greatest invention of the Age. The result of years of experimentation.

Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages
Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

You Can Receive Instantly Without Any Adjusting

3,000 miles is latest record of the Instant Radiograph.
It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.
Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

INTRODUCTORY PRICE FOR FEBRUARY **$3.00**



Cut ¼ Actual Size.

The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.
The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and high; binding posts are made of non-corroding metal, heavily silver plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be proud to have in your wireless station.**
The Radiograph is the greatest recent invention in the Wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalog E of the Instant Radiograph.**
Free—Instant Radiograph—a book you need. "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.

UNIVERSAL WIRELESS COMPANY, 19 East 32nd St., New York

The Boys' Companion

A BOY'S PAPER AT A BOY'S PRICE. ONLY 25C. FOR ONE YEAR. REGULAR PRICE, 50C.

A real boys' magazine, with more departments of interest than any other boys' paper. 32 large pages of clean, fascinating stories and special articles, in addition to our 12 regular departments—Wireless and Electrical, Aeroplane Model Builder, Hunting, Fishing, Trapping, Farming and Gardening, Poster Stamps, Fun and Magic, Athletics, Photography, How Our Boys Make Money, Stamps, and Coins, and Amateur Journalism. The best boys' paper in the country. Lots of pictures. One number may enable you to make many times the small subscription price. Send 25c. at once for a year's subscription and we will send you a set of 10 Chicago view posterettes FREE. 6 months, 15c.; 4 months, 10c.

BOYS' COMPANION, 1122 The Temple, CHICAGO, ILL.

BICYCLE HEADLIGHT.

(434.) W. L. Rodrigues, Charleston, S. C., asks for data on the method of attaching a dynamo to his bicycle to enable him to light a small headlight for same.

A. A dynamo that would be suitable for use on a bicycle would be a 24-watt machine. This should be bolted to the bicycle frame under the seat and a friction pulley on the shaft should make contact with the rear wheel. This machine delivers 6 volts at full speed. And when traveling 5 or 6 miles an hour this voltage will be delivered. Four small dry cells should be connected across the wires to keep the light lit when traveling below this speed. A tungsten lamp should be used so that it would not be burned out when the voltage rises above normal. You can use a clamp for connecting this to the frame and no trouble should be encountered.

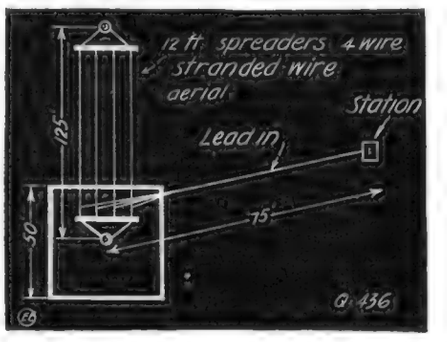
K. V. A.

(435.) Noble A. Allen, Beacon Falls, Conn., writes us asking for the explanation of the term "K. V. A." when applied to high tension alternating currents. As an example he wishes us to figure the horsepower of a transformer stepping 11,000 volts down to 440 volts, which is rated at 100 K. V. A.

A. The expression K. V. A. extended means kilo-volt-ampere. Since the volts times the amperes equal the watts, the expression really means kilo-watts. However, in alternating current work it has been found that the actual voltage and amperage in the circuit and registered on the ammeter and voltmeter and that registered by the wattmeter do not correspond. This difference is known as the "power factor." When the power factor is one or unity, the kilo-volt-amperes refers to kilo-watts. However, when the power factor is other than one the expression "K. V. A." is used to indicate that the volts and amperes as actually flowing in the circuit are meant and the wattmeter reading is to be disregarded. Therefore 100 K. V. A. with a power factor of 1 or unity is equal to 138 horsepower. This figure is obtained by dividing the 100 K. V. A., or kilo-watts, by .746 K. W., which is the equivalent of 1 horsepower.

EFFICIENT AERIAL.

(436.) L. L. Baker, Tulare, Cal., sends us a problem on aerial construction. He has



Special Antenna Layout.

a mast 95 feet high in the center of an area 50 feet square. The station is to be located 75 feet east of the mast, and he has means of fastening an aerial 60 feet high 125 feet north of the plot of ground. He desires to know which would be the most efficient aerial under these conditions.

A. We show herewith the plan of an aerial that will be most efficient under the

conditions mentioned in the question, and it will have a natural wave length of approximately 350 meters.

BUZZER TRANSMITTING.

(437.) Charles Welsh, Philadelphia, Pa., sends us a drawing of a buzzer set and wishes to know: 1. If it is practical? 2. How to connect a tuning coil and loose coupler? 3. What could be added to increase the sending radius of a buzzer set.

A. 1. The hook-up you show of the buzzer transmitting outfit is impractical for several reasons. The principal reason is that the buzzer A will not operate, due to the fact that the vibrator on this buzzer is not connected in the return circuit to the battery.

A. 2. A tuning coil is generally used as a loading coil in connection with a loose coupler. This is accomplished by connecting the instrument in series with the aerial lead.

A. 3. To increase the sending radius of a buzzer outfit the addition of a kick coil in the circuit will have the effect of increasing the range. This coil will cause larger sparks at vibrator points, which will in turn energize the aerial in a more powerful manner.

CURRENT REDUCER.

(438.) Geo. Outen, Oberlin, O., asks: 1. How to reduce 600 volts direct current to

Use of Water Rheostat in Reducing Voltage.

110 volts? 2. The wiring diagram of a receiving set using two audions. 3. Is it necessary to use an interrupter on a 1-K. W. open core transformer operated from 110 volts direct current?

A. 1. The cheapest method of reducing 600 volts direct current to 110 volts is by the use of a water rheostat or some form of wire resistance. The rheostat may be made according to illustration herewith, or if a wire resistance is preferred you may use 2 pounds of No. 20 German silver wire wound on some sort of a form. Either of these arrangements will pass 5 amperes.

A. 2. For hook-up on a set using two audions we refer you to page 489 of the January, 1915, issue of this magazine.

A. 3. The usual practice when a 1-K. W. transformer is to be operated on a 110-volt direct current supply is to utilize a rotary converter. The rotary consists of a machine that takes direct current on one side and delivers alternating current on the other. This is the best method of operating a transformer, as an interrupter for handling 10 amperes at 110 volts would be very noisy and expensive.

ELECTROLYTIC INTERRUPTER.

(439.) Milford M. Henderson, Salt Lake City, Utah, desires to know: 1. The constituents of the electrolyte in an electrolytic interrupter. 2. What range can be covered with an aerial 35 feet long and 25 feet high, using a buzzer and condenser and standard hook-up for such an arrangement. 3. A wiring diagram for three ½-inch spark coils and one make and break coil with an electrolytic interrupter.

A. 1. The solution used in electrolytic

Everyone is talking about the Electro-set Co.'s

ARLINGTON TESTED MINERALS

A.T. GALENA A.T. SILICON

Why Buy Minerals on a Gamble?

The least expensive and the *most important* part of your wireless equipment is the mineral in your detector.

An expensive receiving equipment will do only mediocre work if the detector is not sensitive.

Don't Neglect This Important Point.

It costs mighty little to get extremely sensitive minerals. But it requires caution. Look carefully where you buy. To be *sure* accept only

Electro-Set Wireless Minerals.

Every package marked thus

GENUINE ELECTRO-SET MINERAL

Look for the Signature

J. S. Newman PRES.

Read What Others Say!

A few letters selected at random from our files.

Milan, Ohio.

The Arlington Tested Galena Crystal that I bought of you some time ago has given the best service, by far, of any crystal I have yet used.

Yours very truly,
RALPH H. SAYLES, Jr.

N. Manchester, Ind.

I received your N A A Tested Galena. It is more satisfactory than advertised.

Yours truly,
EUGENE SMITH.

Purcell, Okla.

I received the N A A Minerals last week, and I want to tell you that better results have been obtained with them than with any other. Yours truly,
JACK GILLETTE.

THE PRICES ARE HIGHER

They have to be. Our buyers scour the world for these supremely good minerals—but remember, after all, that even Electro-Set Minerals are not too high priced for the smallest pocketbooks.

ELECTRO-SET ARLINGTON SILICON

Electro-Set Arlington Test Minerals are wrapped in tinfoil and packed in convenient tin containers. They should be handled only with pincers and are preferably used in dust-proof detectors.

Arlington Tested Minerals

INDIVIDUALLY PACKED AND TESTED

N A A **Galena,** each crystal carefully tested by experts for distant stations. Individually wrapped and packed in tin containers. Postage paid..... 25c.

N A A **Silicon,** individually tested, wrapped and packed. Postage paid..... 25c.

N A A **Zincite Couple,** specially selected, tested and packed. Extremely sensitive. Postage paid..... 50c.

Triple "A" Grade Electro-Set Minerals

Packed in convenient one, four and sixteen ounce cans

These ultra-sensitive minerals are the only ones you should buy. Look for the original signature on the wrapper.

PRICE LIST OF TRIPLE "A" GRADE MINERALS

	1-oz. Can	4-oz. Can	16-oz. Can
Galena	25c.	60c.	$1.50
Silicon	25c.	75c.	2.50
Bornite	25c.	75c.	2.50
Copper Pyrites	25c.	60c.	1.50
Iron Pyrites	25c.	50c.	1.50
Molybdenite	25c.	70c.	2.00
Carborundum	25c.	60c.	1.50

Zincite, Pine, per ¼ oz. Can, 50c.

Prices are prepaid

Electro-Set Mineral Outfits 50c.

These popular outfits have met universal approval. At a low cost they offer the experimenter a good selection of minerals for testing and experimenting.

Five different minerals are packed in individual containers and are sent prepaid anywhere.

Triple "A" Minerals are Furnished. Galena, Silicon, Molybdenite, Bornite, Carborundum. Complete set 50c.

FREE
With each outfit one piece phosphor bronze cat whisker wire.

ELECTRO-SET DETECTOR OUTFITS

This outfit consists of the following:

1 set of 5 different minerals in individual tin containers.
2 nickeled binding posts.
1 support post.
1 detector cup.
1 brass rod, threaded.
1 insulator knob
1 polished wood base.
1 ft. phosphor bronze wire,
nuts, screws, etc.

Experiment with different types of detectors. A mighty interesting and reasonably priced outfit, complete as described..... $1.25 prepaid.

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We manufacture 63 interesting wireless and electrical specialties and are agents for the following standard lines:

Brandes 'Phones (Middle West Distributors). Murdock' Phones and Apparatus. Crystaloi Detectors. De Forest Audions. Bunnell Apparatus. Westinghouse Motors and Generators. Clapp-Eastham Apparatus. Flexible Wireless Transformers, and many others.

Dept. 410 **The Electro-set Co.** 1874 E. 6th St. Cleveland, O.

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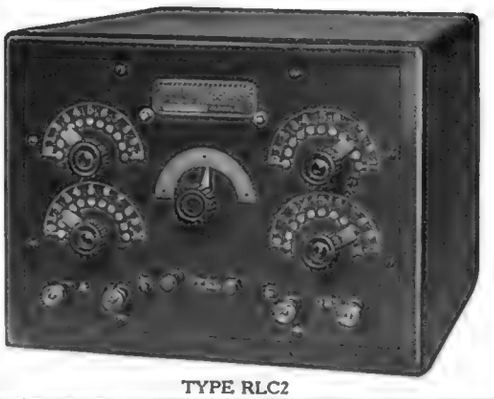
"Mignon System"

Apparatus of Scientific Construction for the Reduction of Static Interference

High Resonance—Unapproached Selectivity

NO TICKERS NOR ARMSTRONG CIRCUITS REQUIRED for the reception of CONTINUOUS wave signals if you own a MIGNON-SYSTEM CABINET



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De Forest Audion Detectors and Amplifiers

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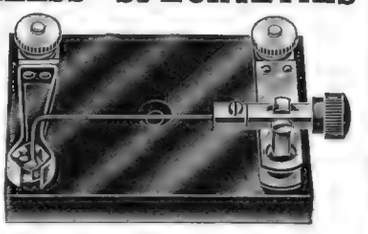
MIGNON WIRELESS CORPORATION

ELMIRA, N. Y., U. S. A.

2 NEW BUNNELL WIRELESS SPECIALTIES

The Jove Crystal-Detector-Holder is the simplest, handiest and most perfect arrangement yet produced. It holds crystals without using clamp screws.

It firmly holds crystals of different minerals at the same time—change of contact from one to the other can be instantly made; a sensitive point quickly found, and the correct pressure held constantly, all without using a single screw or nut. It is designed and finished in our well-known high grade style. Mounted on dark enameled porcelain base with metal parts nickel-plated and highly polished. Postage weight, 1 lb. Price, Net $1.00



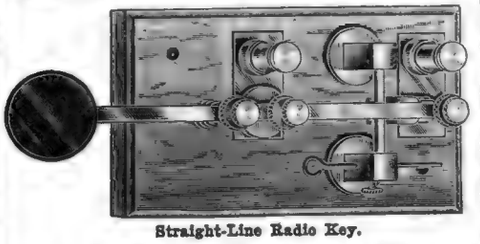
Jove Crystal-Detector-Holder.

The Straight-Line Renewable-Contact Radio Key is much superior to other types of Radio Keys.

Not only are the contacts renewable; but, no matter how much worn, full contact surface can be maintained between them, and the lever retains its normal horizontal position.

This is accomplished by mounting the upper contact on an adjusting screw, which is threaded through the lever and held in position by a check nut. The lower contact is so arranged that it may be loosened for adjusting.

By holding the lever down, with lower contact loose, and then clamping it, perfect surface alignment between the faces of contact pieces is secured, and thus fading or irregularity in strength of signals caused by varying resistance of contact points is eliminated and the contact pieces may be practically used up before renewal becomes necessary.



Straight-Line Radio Key.

Another desirable feature of our Straight-Line Radio Keys is the self-clamping binding posts with which they are equipped. These posts make loose connections impossible.

The Keys are mounted on heavy, polished marble bases (6 in. x 3½ in. x 1 in.). The metal parts are heavily nickel-plated and polished, making a strikingly handsome symmetrical instrument.

Price, with ⅜ in. hard silver contacts; postage weight, 4 lbs..... net, $7.50

Send for descriptive circular and copy of our Wireless Catalog.

THE J. H. BUNNELL CO., Inc., Electrical Manufacturers, "Dept. EX", 32 Park Place, New York City

Jensen Electric Co.

RADIO APPARATUS and SUPPLIES

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We are a distributing point for AudioTron Bulbs $6.50

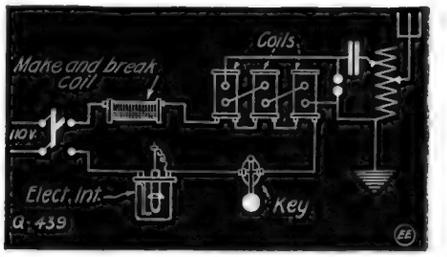
IF THE ELECTRICAL EXPERIMENTER

is good reading once in a while, it is better when read regularly. To make sure that you get your copy, you should subscribe. There's a convenient coupon and a wonderful offer on page 597

interrupters consists of a mixture of 1 part sulphuric acid and 5 parts water, or a 16⅔ per cent. solution.

A. 2. With an aerial of the size mentioned and the buzzer transmitting outfit you may cover 1 mile under very favorable conditions. The hook-up suitable for such an outfit was given on page 352 of the November, 1915, issue of this magazine.

A. 3. We give herewith a diagram of connections for wiring three ½-inch spark coils. The make and break coil should be connected in circuit as shown to control the input to the interrupter. We do not



Operating Three Spark Coils with Electrolytic Interrupter.

advise the use of such small coils with an electrolytic interrupter, as the unduly high voltage of the secondary has a tendency to puncture them when used for a short time.

POULSEN TIKKER.

(440.) LeRoy D. Brown, Winkelman, Ariz., wishes to know: 1. What instruments are required to receive messages from a station using a Poulsen Arc? 2. How to protect his instruments from being destroyed by a near-by high power radio station? 3. The construction of a ¼-K. W. transformer?

A. 1. To receive messages from a Poulsen station you will require some form of a tikker or oscillating audion. The former consists of a special form of circuit breaker and can easily be made by mounting a small brass disc on the shaft of a toy motor and then filing a groove around the edge of the disc with a triangular file. A fine spring brass wire is laid in this groove and connections are made to the motor frame and the fine wire. The apparatus is connected in series with the 'phones and has the effect of breaking up the high frequency oscillations so that they become audible in the head set.

A. 2. To protect the instruments from near-by high power stations the usual practice is to connect a micrometer gap across the primary leads of the loose coupler. A Geissler tube may be used for the same purpose, the extra strong signals being conducted direct to the ground.

A. 3. A ¼-K. W. transformer may be constructed on a square iron core having a cross section 8 inches square and outside dimensions of 6¾x5⅜ inches. The secondary core is insulated with a layer of mica and two layers of Empire paper. The secondary consists of 2 pounds of No. 34 enameled copper wire, or 16,000 turns. The primary is constructed from 3½ pounds of No. 16 D. C. C. wire, which will be enough for 485 turns. The input on this transformer will be 3½ amperes at 110 volts.

FILMS FOR CONDENSER.

(441.) Theo. C. Braun, Jersey City, N. J., wishes to know if film negatives can be used as the dielectric in a condenser for receiving purposes.

A. The material used in making films is ideal for constructing small receiving condensers, but it is necessary to remove the emulsion from same. The sensitive mix-

ture used on films contains silver nitrate, which is a conductor, and it would have to be removed by soaking in water and carefully scraping the film.

TRACTIVE MAGNETS VS. SOLENOIDS.

(442.) James Dowdall, Brooklyn, N. Y., desires information on: 1. Which is the best type of magnet to draw up a weight of 1 pound a distance of 2½ inches from the pole pieces? 2. Where to purchase platinum wire as used in gas stove igniters and its price? 3. Whether dry cells will perform their work if exposed to freezing temperature?

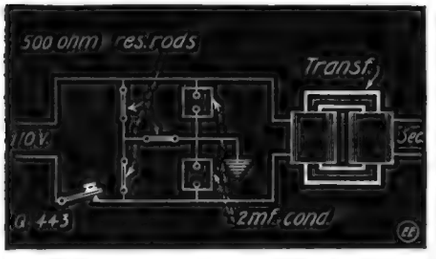
A. 1. When a weight is to be moved 2½ inches it is the usual practice to utilize a solenoid for this purpose. A solenoid having a magnetic pull of 2½ inches requires much less current and is much smaller than any magnet that will do this work.

A. 2. The platinum wire used in gas stove igniters is of very small size, and we do not know if same can be purchased separately. However, you may take up the matter with dealers in experimental apparatus who may be able to quote you on this fine wire. Refer to our advertising columns.

A. 3. A dry cell will perform its work perfectly when subjected to the temperature of freezing water, but when the cells are cooled to such a point where the small amount of moisture in them is solidified the resistance will be increased and the output lessened.

KICK-BACK PREVENTER.

(443.) Raymond Guy, Tottenville, N. Y., asks us for information on: 1. The construction of a kick-back preventer. 2. The wave length of an aerial 55 feet long and 40 feet high. 3. The receiving transformer sold by the Colby Telegraph School, Auburn, N. Y.



Hook-up of Radio Transmitter with Protective Condensers and Resistance Rods.

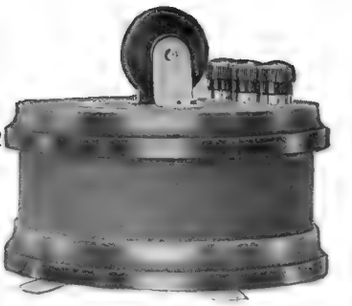
A. 1. A kick-back preventer can be made from 2 one micro-farad telephone condensers which are connected in series across the primary of the transformer and the center connection grounded, as shown in the accompanying illustration. Three resistance rods of 500 ohms' resistance may also be used for the same purpose, as shown.

A. 2. The wave length of the aerial is approximately 165 meters.

A. 3. The receiving transformer sold by the Colby Telegraph School consists of two secondary coils with a slider on each. Inside these coils the primary slides back and forth. By adjusting the position of the primary and the inductance of the respective secondary coils good selectivity is obtained and the signals come in loud.

AUDION QUERIES.

(444.) N. G. Moser, Topeka, Kan., desires: 1. Explanation of the construction of an oscillation gas valve. 2. The theory of the action of such a valve when used as an amplifier and as an oscillation generator.



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A Highly Sensitive and Permanent Wireless Detector That Has Made A Great Record

TYPE AA. SUPER-SENSITIVE
DIMENSIONS 4" x 3½".
PRICE, $6.00
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The CRYSTALOI DETECTOR will do for you exactly what you would have a detector do. It will put you in touch with the *Distant Stations*. It is not affected by near By-Stations. It is capable of the finest adjustment and will last a life time if properly cared for. We guarantee every instrument to be and do everything we claim for it. Ask any one of the thousands that are using them—they are all for us.

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OUR NEW MINIATURE WIRELESS CATALOG describing our complete line of Receiving Apparatus can be had for five cents in stamps.

REMEMBER WE ARE SPECIALISTS in wireless Receiving Apparatus and our products are of the highest grade obtainable.

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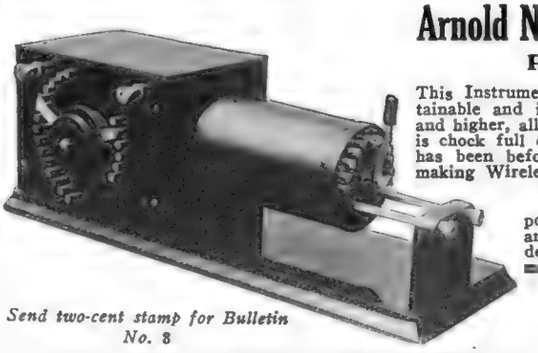

Arnold Navy Type Loose Coupler

PRICE, $15.00

This Instrument is made of the best Material obtainable and is equal to others selling for $18.00 and higher, all fancy prices and frills are eliminated, is chock full of value and is made by a man who has been before the public for the past 5 years making Wireless apparatus.

It will tune up to 3,500 meters.

I also stock the finest line of switch points, Hard Rubber knobs, Cabinets and accessories on the market. Prompt delivery of all orders has distinguished me.

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YOU PROFIT

By reading this magazine. Why not help your friend by giving him this magazine when you have finished reading it?

YOUR FRIEND WILL THANK YOU HEARTILY

Only $5.00

"Receiving Transformer arrived O.K. and I heard Por Arthur, two feet from 'phones, as soon as I got it connected I don't see how you sell such a fine instrument so cheap Ralph Ziegenbein, Houghton, Mich."
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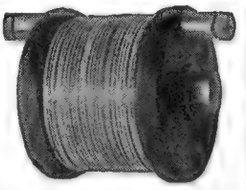
Colby's Telegraph School, Auburn, N. Y.

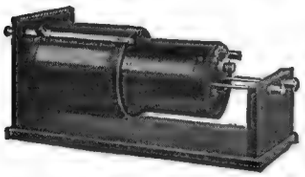
"MONOTONE" QUENCHED
SPARK GAP



Why dissipate your radio energy in sound and light waves? Carry it to the diaphragm of the distant receiver on pure waves of Radio Energy. Every station should be equipped with "Monotone" Quenched Spark Gaps for penetrating great distances. Span that "freak" distance every night. Silent in operation. Arcless. In single units as illustrated for spark coils. Two units in series and multiple for every quarter K. W. power of transformer. Price per unit, $1.50, prepaid.

RICHARDSON COMPANY, Commerce Bldg. ERIE, PA.

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $4.50



Positively unequaled for the money. Is 6" high, 6" wide, and 14" over all. Wound with Enameled wire, and has a very unique slider. Woodwork mahogany finished. Try one, you will not be disappointed.

5c. in stamps brings our 64-page illustrated catalogue, B-B-24. None otherwise.

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BOSTON WIRELESS

Rotary Condenser, 43 plates, .001 M.F., $3.75
Tuner, $2.50. Spark Gaps, 60c. and $1.00
Detectors, $1.00, $1.75, $4.00
Loose Coupler, $7.50, 1500 Meters

Agent for A. W. Bowman & Co., Adams-Morgan Co., Manhattan Spark Coils. Catalogue for 2c. stamp.

M. MUELLER, 18 Devonshire Street, BOSTON, MASS.

READ the Classified Advertisements in this issue. They are small but contain big bargains and opportunities.

3. The method by which the recent tests from Arlington were carried out.

A. 1. The oscillation gas valve or audion consists of a glass bulb within which is mounted a small lamp filament, preferably of tungsten or tantalum, a small grid made by winding nickel wire in a zigzag shape and a small plate of nickel. The bulb is exhausted by means of a vacuum pump and sealed off. Connections are made to the ends and the center of the filament, to the grid and to the plate or wing.

A. 2. Such a valve and its operation as amplifier is discussed at length in the January, 1915, issue of this magazine on page 488, but, briefly speaking, the theory is as follows: When energy flows into the tuning apparatus it causes an increase in the number of ions given off by the glowing filament. These ions lower the resistance between the grid and wing, and cause a momentary flow of current in the phone circuit. This circuit contains inductance and capacity, and will therefore oscillate. This current oscillating in the phone circuit reacts on that in the tuner circuit, which in turn further affects the ions flowing through the vacuum, causing an increase of the oscillations in the wing circuit. This action repeats itself and explains the amplification of signals. The above effect takes place when the grid circuit is not tuned to the same wave length as the tuner circuit. When the inductance and capacity in the wing circuit is nearly equal to that in the tuner circuit the oscillations set up will react on the incoming signals to produce beats. By this means it is possible to receive undamped waves.

A. 3. In the recent radiotelephone tests from Arlington to Honolulu and Paris 300 Kenotron tubes were used at the transmitting end and each tube handled ½ kilowatt of energy. The microphones were connected in the circuit in such a manner as to control the ionic flow in these tubes. In this manner the high frequency currents flowing to the aerial were controlled. At Honolulu and Paris elaborate receiving sets were installed which included audion amplifiers.

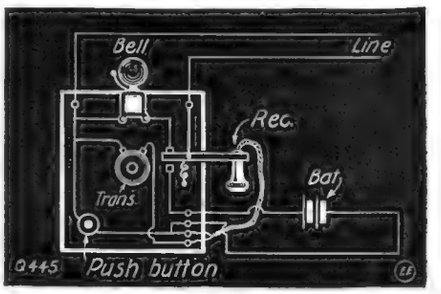
MAGNETO CONSTRUCTION.

(445.) Arthur Paul, Hilton, N. J., sends us a drawing of the armature of a small magneto he is constructing from parts of a motor-cycle magneto and desires information: 1. On the size of the wire, etc., required to finish the machine. 2. Why the coupler he has constructed will not respond to wireless signals, although it seems to be all right when tested with battery and buzzer. 3. The connections for a small, short-range telephone he has under construction.

A. 1. The armature of your magneto should be wound full of No. 24 S. C. C. or enameled wire and a two-part commutator placed on the shaft. The leads from the coil are to be soldered to the segments of the commutator in the usual manner, and two brushes should be arranged to take off the current. With this arrangement and the machine running at about 1,800 r.p.m., you will obtain in the neighborhood of 8 volts and 4 amperes if the magnets you use are of standard strength.

A. 2. It appears that there is an open circuit in your coupler through which the buzzer test has no trouble in flowing, but the current received in the aerial is not strong enough to break down the resistance at this point. We suggest that you examine the coupler carefully and look for open circuits, paying particular attention to the connections between the secondary coil and the leads to the rest of the instruments.

A. 3. We show herewith the proper diagram of wiring for your short-range tele-



Short Range Telephone Set Hook-up.

phone. The transmitters and receivers are connected in series, and the batteries at both stations should assist each other.

AUDIONS.

(446.) D. Currair, Binghamton, N. Y., asks us for information on the construction of the audion detector.

A. In our answer to questions No. 444 we give information on the constructional details of audion detectors. We would like to say that it is practically impossible for an amateur, unless equipped for extra fine glass blowing, to construct these instruments, and only satisfaction can be obtained from the factory-made apparatus.

TRANSFORMERS.

(447.) Carl L. Flory, Eaton, O., writes us, stating that he has a transformer which steps 110 volts up to 880 volts. He desires to know the dimensions of a transformer which would step this 880 volts up to 20,000 volts or more for wireless purposes.

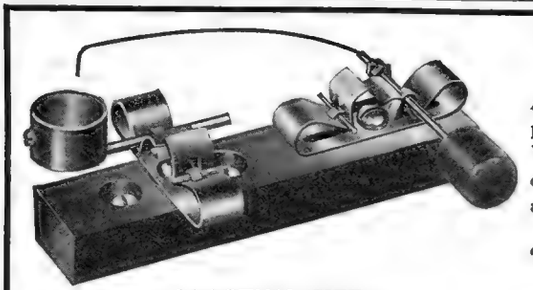
A. We do not approve of the use of two transformers as you suggest, although the scheme will work. It is much cheaper in the end, and the apparatus will be more efficient, if a single transformer is constructed that will deliver 20,000 volts when operated direct from the 110-volt supply.

XMAS CHEER VIA WIRELESS.

Christmas greetings by wireless were sent by President Oswald Becker, of the Davenport (Ia.) Rotary Club, to the heads of Rotary clubs in eleven cities in Iowa and to Omaha, Neb.

The novel form of "Merry Christmas" was relayed out of Davenport by W. H. Kirwan, construction superintendent of the Otis Elevator Co., who has established one of the most powerful radio stations in the Middle West at his home.

Since setting up his radio station Mr. Kirwan has organized a large number of the young men interested in the science into a club for study and practise. He was formerly in the naval service of the United States and served as an electrician in the Spanish-American War. He daily intercepts messages from the United States Government station and from stations all over the United States.



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POSTPAID, 50 CENTS

"SOME" DETECTOR!

Absolutely the simplest and most practical Detector of the Cat Whisker type yet devised. Lacquered Brass for the metal parts and Polished Fibre for the base.

Has the usual merit of the "Winger" products.

Winger Electric & Mfg. Co.

711 So. Dearborn Street, Chicago, Ill.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

MERCURY ARC LAMP.

(43.) R. E. Benson, Trinity, Texas, has submitted to us a novel mercury arc to be used in connection with a motion picture machine. He wishes to know if his invention is practical and whether it will do the work. He furthermore desires to know if it would be a paying improvement. Also, from whom he can obtain explicit information concerning the mercury arc.

A. The scheme submitted is indeed novel and although it will not work exactly as shown in our correspondent's drawing, for the reason that the mercury arc cannot be maintained in a fixed position but must be changed when lighting and extinguishing, we think that by adding several minor improvements the idea can be worked out successfully. We think that an improvement of this kind might work out to advantage, although we do not venture to say that the public would like green moving pictures which result from using a mercury arc. However, by interposing color filters, the greenish light might be done away with, although this is a very difficult thing to do with the mercury arc lamp for the reason that it has no red rays in it whatsoever.

We would advise our correspondent to get in touch with the Cooper Hewitt Co., Hoboken, N. J., and by sending for their catalogs, etc., much information can be had as to the mercury arc and its functions.

NON-REFILLABLE BOTTLE.

(44.) M. Robertson, Nyack, N. Y., submits sketch and description of a non-refillable bottle; he desires to know if it is patentable and if it is of any value.

A. This bottle, like many other non-refillable bottles of which several thousand have been patented in the past, undoubtedly shows some novel points, but we are not sure whether it can be patented on account of so many patents existing in the art. The wisest thing to do would be to get in touch with a patent attorney and obtain references on non-refillable bottles and see what has been accomplished before. There is undoubtedly a market for a simple non-refillable bottle that should have the following advantages:

The device must be cheap to construct and must be made in such a manner that it cannot be detached from the bottle without actually breaking the latter. It should not have any metal parts if possible, as some liquids, particularly spirits, do not improve if they come in touch with certain metals.

AUTOMATIC ELECTRIC CONTROLLED GATES FOR GRADE CROSSINGS.

(45.) Bertram Farnham, East Saugus, Mass., claims to have invented a system of automatic electric controlled gates for grade crossings. The train is supposed to ring a bell, work a signal and put down the gates and raise them again after passing of the train. He wants to know if such a device should be patented and if it is of any value.

A. As stated before in these columns, the railroads as a rule do not favor electrically controlled systems as they are not reliable enough from one season of the year to the other, but without knowing the merits of the invention it is impossible to state our full opinion.

In some sections of England there exists to-day automatic electric controlled gates, but we do not know how successful they have been. There is, however, no doubt in our mind that systems of this kind will come into vogue more and more.

ANTI-COLLISION DEVICE FOR RAILROADS.

(46.) V. G. Johnston, Marshallville, Ga., informs us that he has a satisfactorily working device for the prevention of head or tail-end collisions on railroads by employing a method for signaling in the cabs of the respective locomotives in danger. Our correspondent states that the whole outfit will cost approximately $10 to install, and he furthermore wishes to know our views concerning the device, if the railroads would be interested in such an idea provided the scheme works entirely satisfactorily.

A. Without knowing the nature of the invention, it is impossible to give intelligent advice. Merely a low price would not interest the railroads if there were some functions connected with the device that did not make it entirely "fool-proof" under all conditions.

Railroads usually look askance at devices of this kind, particularly electric devices that work by contact, for the reason that they work well in good weather, but they might not work in case of a snowstorm, when ice covers the right of way or in case of a wash-out.

It is always well to bear in mind that the average railroad accident does not happen under usual conditions, but rather the unusual, where the human element does not perform its functions as it should. The average railroad man, although he is cautioned against it, thinks that certain accidents will never happen on account of certain conditions, and it is usually on account of taking things for granted that accidents do happen.

We would advise our correspondent to get in touch with a patent attorney as soon as his invention has been perfected.

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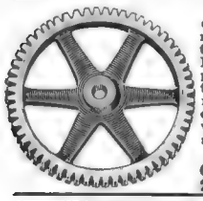

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HOW VESSELS AT SEA SIGNAL THROUGH THE WATER.

(*Continued from page 534.*)

tween two discs drawn together on the tube by a one-inch steel rod and a right-and-left-handed screw thread.

Telegraphing with this Fessenden oscillator is accomplished by means of an ordinary telegraph key placed in the main armature circuit. No undue sparking takes place at the contacts of same; this is due to the fact that the armature has substantially no self-inductance and thus no eddy currents are generated in the apparatus. A 500-cycle alternating current is used. The apparatus is usually of considerable size and is rated at several kilowatts.

When the oscillator is placed on a vessel or hung overboard, a large water-tight diaphragm is attached to it. This particular form of oscillator was first tested between a lightship and a tug 31 miles apart. A later test under severe conditions has established the fact that signals may be transmitted reliably upward of 20 miles, while the vessel transmitting the signals is running at full speed. Quite remarkable indeed is the fact that the Fessenden oscillator may be in turn used for receiving the sound waves, due to the fact that the alternating current reaction is similar to that of motors of the alternating current induction type. In most cases, however, the usual microphone picks up the sound waves which are transmitted by such oscillators.

A very important field for these submarine signals is that involving submarines. These little terrors of the undersea, especially when running submerged, have scant means at their command to communicate with any sister vessel or with the mother ship. In the United States navy tests made

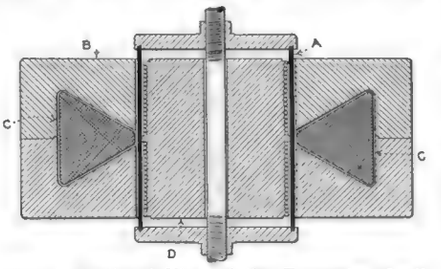
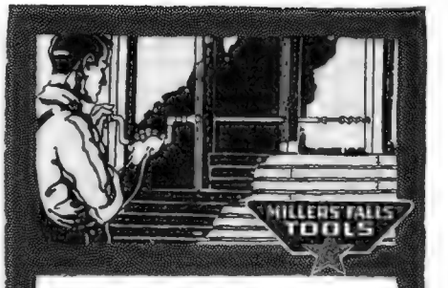


Fig. 3. Sectional View of the Fessenden Oscillator for Submarine Telegraphy.

with these submarine signals some time ago reliable communication was established and maintained for a distance of several miles between boats. It is also possible for a submarine to signal any vessel equipped with submarine signaling apparatus that she is in distress, and it is also possible for lifeboats to carry a submarine signal bell, so that in case they should be estranged or lost during rescue work at sea they could send out distress signals giving their locations, etc., in order that the ship to which they belong will know what to do. Science will eventually rob the sea of all its terrors, or at least those besetting the traveler.

THE RADIO PROFESSION.

One profession that is not overcrowded in the United States is that of the radio operator. The United States in case of war would find it a difficult matter to secure enough professional operators for all of the ships and stations. In that emergency the Government's only resource would be the 250,000 amateur operators in all parts of the country, who really accomplish excellent work in this interesting field. Many are just bungling beginners, of course, but there are also a large number of competent operators among them.



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THE TRENCH TRACTOR.

(*Continued from page* 536.)

induce the men to leave their trench, and, secondly, if they persist in remaining they stand a good chance of being bayoneted or otherwise becoming exterminated by their foes. Incidentally the tractor, being enveloped in a cloud of steam, is protected in a certain degree from the enemy's shell fire.

If a dozen or more tractors of this kind were sent against a line of trenches, it is difficult to see how the enemy could hold them.

"So far so good," my wise friends will observe; "but suppose the enemy, too, has Trench Tractors. Suppose that the 12 French Tractors rush against the 12 German ones. What then?"

In answer to this the writer points to the submarine war and its recent collapse. As long as the submarine could not be combated it raised havoc, the same as the Trench Tractor will raise havoc till it can be combated. But the submarine is now combated by the electric submarine "ear," and the battleship—but a few months ago relegated to the scrap heap—has come into its own once more.

So it will be with the tractor. It will make trenches untenable and thus its importance becomes inestimable indeed, for it will put the men in the field, *where they belong,* not in the trench scrap heap. No war can ever be won if the men stay in the trenches. If there had been no trenches the European war would have been over in six months.

THE ELECTRO GYRO-CRUISER.

(*Continued from page* 543.)

mor of (h), serves double purpose as armor and as the bearing seat and guide for a system of huge ball bearings; (m) is a ball bearing five feet in diameter and probably of solid steel; (m) and its fellows roll in the space between (1) and (l).

This system of bearings will be able to carry a weight of thousands of tons at a rotation speed of 60 miles an hour—which would be only 30 miles an hour between the ball and either one of the bearing surfaces—with minimum friction, wear and trouble, and with the maximum reliability of any system which may be devised, even as it is so with more modest types of ball bearings.

(n) is a section of the armature res of the very powerful two-speed electric driving motors. The two multi-polar motors are each about 70 feet in diameter. On low speed they will be able to force the gyro-cruiser over rough country and directly up steep grades, while very steep grades will be overcome by a zigzag ascent. On high speed the twin motors will be able to rotate the great wheel at 15 or 16 revolutions per minute, a rate at which the cruiser will be making 60 miles an hour over the road.

(o) is an armature coil; (p) is a field coil; (q) is the field core; (r) is the commutator; (s) is a brush which plays between the commutator and the slip rings (t).

The brushes are mounted on miniature electric trucks which run upon a circular track laid inside of the commutator, and their velocity of movement over the track, as well as their position at any time, is controlled from the bridge. The significance of this method of control may be seen upon a little reflection.

(t) slip rings mentioned; (u) is the space in which is the commutator controlling the rotating magnetic fields of the liquid gyroscope; (v) feeders running from gen-

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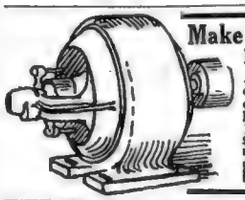

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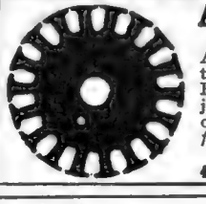

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erator to motors; (w) brushes taking current from the slip rings (x); (x) slip rings; (y) feeders from the brushes (z) to the slip rings (x); (z) brushes taking current from the generator's commutator; (Z) commutator of the generator; (Y) armature of the generator; (X) field coil; (W) field core; (V) is the shaft direct connecting the 40,000 horsepower generator to the 60,000 horsepower Diesel engine; (U) bearings; (T) crank case of the engine; (S) cylinders; (R) exhaust; (Q) oil and water intake pipes; (P) partitions and fuel storage tanks; (O) is a passage between the fixed and the rotating structures.

Despite the rotation of the great wheel the engineers' force will have their regular stations. Provision will be made for the protection and comfort of the men who must work in this structure. The rotation will be at the maximum very slow, as we have seen; and it is thought necessary or very desirable that as much of the weight of the gyro-cruiser as may be possible be carried inside and as a part of the great wheel.

(N) is a girder and part of the wheel's framed structure; (M) is also a part of the framed structure. (M) provides additional space for fuel and water tanks and various other storage. In the unmarked spaces of the fixed structure—outside the broken line—will be yet other storage spaces and rooms devoted to crews' quarters and to the thousand and one other incidentals of a giant fighting machine; (L) is a man on tiptoes and arm extended to the foot of the machine. This shows the comparative size. It may here be noted how the sharp foot of the wheel cuts into the earth. This cutting power will be the only "springs" which the gyro-cruiser will need. The bevel and shape of the foot will be a matter of nice calculation and much experimenting to determine the design best combining for an average soil the maximum cushioning effect of the cutting act with the minimum practicable friction between the wheel and the cut.

(K) 50-foot tree shown for comparison; (J) a barbed wire entanglement which, in this case, might as well be made of cobweb; (I) rampart; (H) is a trench with its machine gun helpless and silent to this foe.

We will now consider the liquid gyroscope, the detail, longitudinal section of which is shown in Fig. 3. We will not argue with you as to whether or not it may be possible to construct a solid gyroscope of 2,000 tons weight, or as to whether or not it may be practicable to divide that weight among a number of smaller wheels. We do not think that the one is possible or that the other is practicable, but we will allow anyone his own belief. The first governing condition with which we are met is that the mass of our gyroscope must be driven at an average circumferential velocity of some figure between three and eight miles a minute. Taking eight miles per minute, or 704 feet per second, as a maximum velocity and allowing 40 feet as the average distance from the axis of rotation to the rotating mass, we find that the maximum centrifugal force or bursting effort of the 2,000-ton gyroscope will be 770,500 tons. At a circumferential velocity of three miles per minute the burtsing effort will be 36,200 tons. It is probable that the gyroscope will not need to be operated at a much greater velocity than three miles per minute, in which case 500 tons of steel in the armored rim (h) would be fully able to take care of the bursting effort. But even if velocities approaching eight miles per minute were found desirable 10,000 tons of steel—elastic limit of 15 tons per square inch—would suffice. This last

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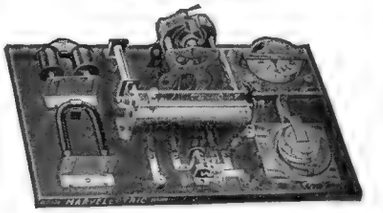

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case would give a cross sectional area of steel in (h) of 100 square feet, which is the area of a triangle, 20 feet at the base and 10 feet in height. These figures reveal the limits within which we must work.

Referring again to the diagram, Fig. 3, we have a circular tube—diameter 100 feet over all by 25-foot cross section—bounded on the outside by the iron case (A) and lined within with non-magnetic steel sheeting (B). (i_1) represents iron rings serving as pole pieces for the magnet coils lying between them. (i_2) indicates spaces in which are wound the large magnet coils encircling the sheath (B). (j_1) is a spiral of non-magnetic steel, and which makes six turns around the inside of the tube in making one circuit. (j_2) is a second spiral which is set one-half turn in advance of (j_1). These spiral guides cause the liquid, when making one circuit around he primary axis of the tube, to make six turns about the secondary axis—which is a circle and is the line joining the centers of cross sections of the tube. (k) are 12 balls of hollow iron shell and structural steel core construction. Each ball is 15 feet in diameter, weighs about 40 tons and has about 10 tons of buoyancy. The balls are held in their relative positions by the magnetic fields of the coils (i_2). Thus, due to these coils, we should find a north magnetic pole between the first ball (k) and the next ball to the left of (k), a south pole between ball No. 2 and ball No. 3, north pole between ball No. 3 and ball No. 4, etc. The liquid to be first employed will be water, although hot, liquid-fusing metals may be later employed, or mercury—if we ever penetrate to the more plentiful deposits of that useful metal which quite likely lie deeper down in the earth's dense bosom. Almost exactly 2,000 tons of water will be carried in this particular gyroscope. This mass will be whirled by the rotating magnetic fields of the coils of (i_2) sucking with them, as they rotate, their armatures, the balls (k). The magnetic rotations will be controlled by the commutator (u) of Fig. 2. Balls (k) will be prevented from coming in contact with the walls of the tube by the centripetal effect upon them of the spiraling motion given to the water by the guides (j_1) and (j_2). This effect is as simple as the parallel effect in a cream separator, that the light cream goes to the inside, while the heavy milk whirls to the outside. By impressing the spiraling motion upon the water the light, buoyant balls will be held with a great force to the center line of the tube, where, surrounded on all sides by water, they may be sucked by the rotating field at high speed around and around the great circuit with-

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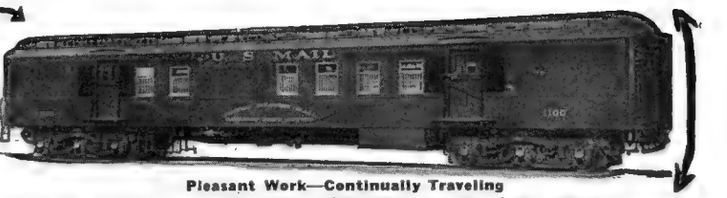

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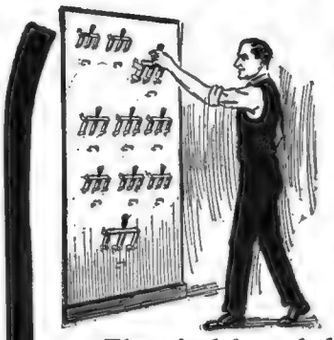

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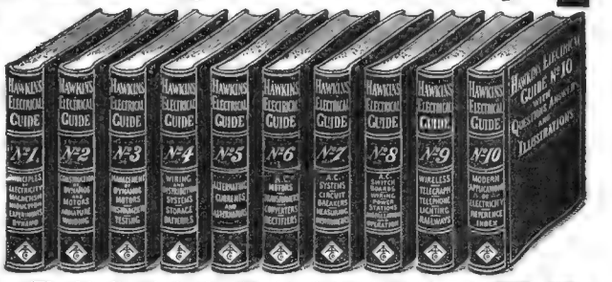

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out suffering or causing any harm and without the gyroscope encountering any friction except the friction of a liquid flowing through a large tube, which, though by no means small, is, fortunately, not of the same order as the friction between a vessel moving in the sea and the water which it passes. This spiraling scheme is the crucial point of the whole idea and is the one thing which raises it from an idle dream to the plausibility and the possibility which it is.

So, in type at least, shall the monsters of the future be created and be set loose upon the land. These giants of a race of toiling machinery will take their places in the trenches which are the valleys, and behind the ramparts which are the hills, and one more freedom will be added to the roll of emancipation and will come out from the nation which loved humanity.

MYSTERIES OF MATTER.

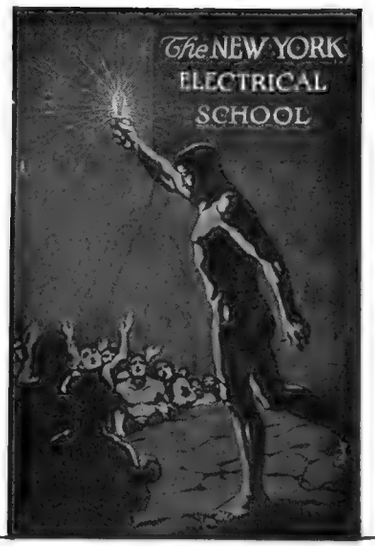
(*Continued from page 549.*)

test state, it is at its lowest point in the scale of evolution, and progress depends on a fall of temperature by radiation. Lockyer's inorganic evolution, joined to the nebular hypothesis, and this to geological and biological evolution, completes the evolutionary cycle of matter to its present terrestrial stage.

We now come to the most interesting, most marvelous mystery of matter. There has been collected a wealth of evidence which proves that the atom is an organized planetary system of dazzling complexity, in which electrons simulate the movements of the planets of our solar system. The negative electrons of the atom swing around the positive nucleus, like planets around the sun. The planet Neptune requires 165 years for a single revolution around the sun, but it has not made a half revolution since its discovery, while the electrons of the atom complete their revolutions around their central nucleus in a millionth or a billionth of a second. The electrons revolve in a series of concentric orbits all in the same plane. While the larger part of the mass appears to reside in the nucleus, the nucleus is relatively minute, with a diameter of probably less than 1/5000 of that of an atom. It is thought that the simpler atoms, such as hydrogen, nebulium and protofluorine, where the electrons are few, all revolve in one ring, but in the heavier and more complex atoms their orbits lie in three to five, or more rings. The atom is as much a machine as an electric motor, and both are electro-magnetic engines.

Nearly the whole mass of the atom resides in the nucleus, but the nucleus is relatively very minute. It is quite impossible to imagine the extreme density of the nuclei. If an oxygen nucleus could be enlarged to a diameter of one inch, its mass would probably be more than 500 tons. If oxygen gas, at atmosphere pressure, could be magnified until the nuclei were each equal to the mass of the sun, we would have the sidereal universe reproduced in which the mean distance between atoms would approximate the mean distance between the fixed stars of the universe. Since the atomic weight of oxygen is sixteen, the atom is supposed to have eight electrons revolving around its nucleus. If we apply the same analogy of magnification to the structure of the oxygen atom, we would have a system of eight satellites in which the relative distances between the revolving electrons and the central nucleus would approximate the distances of the eight planets from the sun. Thus in oxygen gas, the sidereal universe, with its stars and revolving planets, is reproduced in miniature.

It will be seen that the structure of gases



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counterfeit on a very small scale, the structure of the great sidereal universe. Since all the forces acting in the nuclear atom are electrical, may not the forces acting in the stellar universe be electrical? Is not the force of universal gravitation electrical? Should not the universality of law lead us to infer that the force of gravitation is an electro-magnetic force?

It will be seen from the preceding description that the form of the atom is that of a flat disc, which probably possesses elasticity. It was formerly supposed that atoms were spheres of infinite hardness, and of course without elasticity. The atom, and in fact all matter, is immersed in a medium called ether, which is continuous, frictionless and pervades all space. Ether is the universal carrier of the energy of light, heat, electricity and X-rays. Hydrogen has been called the smallest and lightest of the elements, but the sun, stars and nebulas yield still smaller atoms, called proto-hydrogen, asterium and nebulium. The atoms of these very primitive forms of matter are simpler in their arrangement, and easier to calculate than most terrestrial elements. Working in the dark, the alchemist of the Middle Ages attempted the transmutation of metals, without even knowing the nature of his problem. Science has now unveiled the secret of transmutation, by observing nature's process of changing the heaviest element into a series of different products. The alchemist vainly sought to change mercury into gold. We now know that mercury might be changed into gold, if we could expel from its atoms one alpha particle, and a beta particle; or if the metal thallium could be made to expel an alpha particle, it would become like atoms of gold. This has not yet been done but it is possible that it might be done by the application of an electric current of some million volts.

The principal weight of the atom lies in its nucleus, but the nucleus is very small compared with the size of the atom. It contains so-called "sub-atoms" and electrons, in association with positive electricity. The electric charge of the nucleus is therefore overwhelmingly positive. In the breaking up of atoms by radio-activity, the alpha particles (helium atoms) and the beta particles (electrons) are thrown off from the nucleus. In the outer region of the atom there is a sufficient number of negative electrons to balance the central positive charge. It is this outer region that controls the chemical, and much of the physical influence of the atom. It will thus be seen that the radio-active charge is connected with the nucleus, while chemical and electro-chemical properties are controlled by the outer rings of electrons. It is now known that there are relatively few electrons revolving around the nucleus, probably not more than half of the number representing its atomic weight, in which hydrogen is the unit.

The period of revolution around the nucleus, by the electrons, appears to be identical with Kepler's harmonic law of planetary motion, in which electrical force, varying inversely as the square of the distance, takes the place of the force of gravitation. The lightest atom is supposed to have but one revolving electron. This limits the smallness of the atom, because you could not have an atom with no revolving electron. The smallest atom resembles the earth with its one satellite. The heavy atoms have far greater numbers; an atom of mercury would possess a hundred electrons, which is ten times as many satellites as Saturn has.

Lockyer has shown that the younger and hotter stars contain elements fewer in number, and simpler in structure, than the

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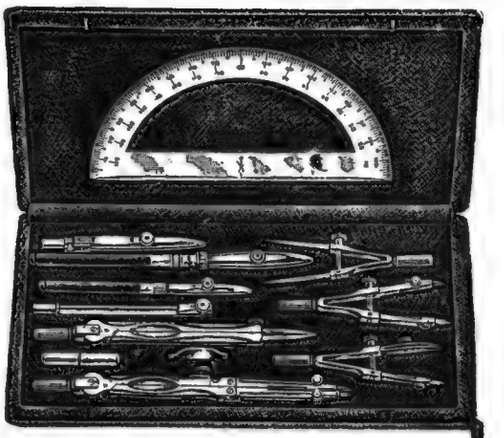

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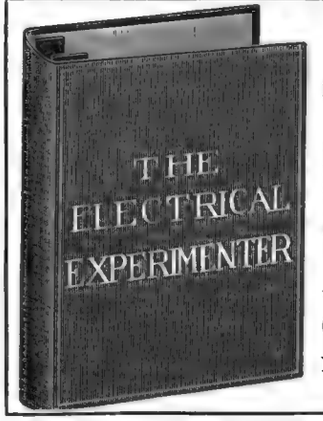

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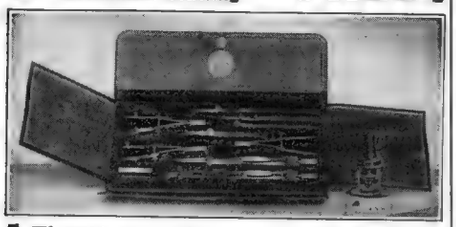

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older and cooler stars. In this fact we face the gigantic evolution of matter from the primitive source of the universal ether, to the complexity of terrestrial organic matter. The mighty machinery of the cosmos is immortal in its operation. Ceaseless change is the only constant thing in nature. The complete cycle of change leads matter through all its phases from the simplicity of the hottest star to the complexity of matter in the planets and in our cool earth.

A recent article by O. Lehmann, on the discovery of the formation of liquid crystals, incidentally confirms the theory, that atoms are flat and not spherical. He assumes that the molecules of these crystals are tiny flat plates whose surfaces are perpendicular to the optical axis. He says, "The molecules easily glide over one another in a direction parallel to their flat surfaces," and concludes that the crystals are combinations of plate-like molecules. Since molecules are small groups of atoms, and some molecules consist of single atoms, it follows that disc-shaped atoms would lend themselves to the formation of flat molecules.

It is probable that the atom is elastic; not perhaps by the pressure that could be secured artificially in the laboratory, but by the gigantic gravitational pressure of the interior of the planets and stars. The earth's interior is so hot that if its pressure were released it would explode into gases of very high temperature. The pressure of gravitation near the earth's center amounts to millions of pounds to the square inch, and there matter is reduced to the density of platinum. Under this force liquids yield like a sponge. Owing to the enormous pressure that gravitation imposes on the earth it is compacted into a dense mass as rigid as that of a ball made from nickel steel armor plate.

We now appear to be on the verge of further discoveries in the nature of matter which may lead to a knowledge of the mysterious, unknown, ether. All intelligent people are interested in new information regarding the swift electrons that light our cities, propel our street cars, operate factories, transmit speech, carry wireless messages and serve man in hundreds of ways. A host of eminent scientists have framed a science of radio-activity which has changed the entire theory of matter, involving conceptions that are difficult to explain to those who have not specialized in physical science. Even the accomplished physicist, Sir William Crookes, says that the conceptions of atomic physics are often hard to understand. We are unfortunately lacking in gifted interpreters of physical science, such as the nineteenth century furnished. Darwin, Huxley, Spencer and Tyndall could clearly explain to the uninitiated, in simple words, the most intricate scientific discoveries of their period.—*Popular Astronomy.*

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(*Continued from page 557.*)

nect the high voltage battery to the binding post marked B B. This scheme has another advantage over the old method, for the experimenter may place any voltage across his instrument and vary it by merely operating the switch handle of the potentiometer. A rheostat for regulating the current supplied to the filament is enclosed in the cabinet and is regulated by turning a rubber handle shown on the right of the cabinet. This is something new for the amateur who is interested in audion detector sets.

An instrument for which the amateur "wireless bug" has long been looking is the recording relay, depicted at Fig. 2, which will operate a sounder, tape recorder and a bell by the regular incoming wireless messages. This consists of an ordinary sensitive voltmeter movement which comprises a strong, permanent magnet in which an armature B is placed between the two field poles C C. The armature B is delicately supported in jewels and carries a contact arm D for making connection with terminal E when it is in operation. The recording or ringing instrument is connected in series with the terminals D and E and a source of current, such as batteries, etc., while the armature B is hooked up with the receiving set in place of the regular 'phones.

The operation of this relay is very simple and the explanation is as follows: As soon as a radio message is received the armature B is deflected or turned and in so doing the arm D will make contact with terminal E, which will complete the circuit of the recording device. Although this device can be used with any sensitive detector, it will work better with an audion and better still with an a dion amplifier. It should also be understood that this instrument cannot be employed where high speed messages are to be received. As the period of oscillation is very large it is impracticable to use this instrument for high speed messages, but it can be successfully employed for calling purposes, etc., that is, to announce to the operator that someone wants him.

THE DUBILIER MULTIPLE MUSICAL TONE RADIO SYSTEM.

(*Continued from page 559.*)

on oscillator b. Fig. 3 shows the complete circuit, where q is a quenched gap, C^3 the high tension condenser and I^1 I^2 oscillation transformer.

The apparatus operating on the above principle is shown in Fig. 4. The oscillation transformer is placed upon the back of the cover of the case as perceived. The gap A is of the quenched type and is constructed of silver and copper bar electrodes. The mechanical vibrator B is used for charging the condenser of the oscillating circuit; the current used by the interrupter is regulated by rheostat C, and the amount recorded by the ammeter D. The high frequency aerial current is read by the hot wire ammeter E. The oscillating circuit is controlled by the condenser enclosed within the case and same is regulated by the handle F. The current is interrupted by a telegraph key located on the top of the shelf, as seen. This outfit is operated on 110 volts D.C. supplied either from a storage battery or a dynamo. The complete outfit weighs 32 pounds, which is marvelously light as compared with any other similar type of apparatus now available. The set illustrated at Fig. 4 is of the pattern used on the French military aeroplanes. The British government is also using radio apparatus of the Dubilier type extensively. They appear to mark a new era in radio transmitting set design, at least where small or medium size outfits are required of the minimum volume and weight.

SEATTLE HEARS RADIO FROM MEDITERRANEAN.

A Seattle dispatch says that a wireless operator there has been able to hear distinctly for several days Italian warships in the Mediterranean talking to one another. He heard the cruiser *Etruria* calling the battleship *Carlo Alberto*. "We hear the Government radio at Arlington every night," said the operator, "and are able to listen in on radiophone calls to San Francisco. We frequently hear radio calls from Japan, Russia and Germany."

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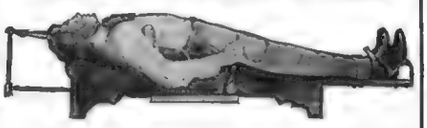

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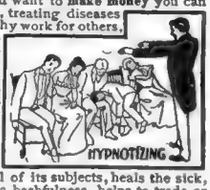

M. D. BETTS,
Sta. 563, Jackson, Mich.

BINDERS FOR THIS MAGAZINE WILL PRESERVE EVERY ISSUE
SEE PAGE 591.

THE SHIRIKARI TENTACLE.

(*Continued from page 555.*)

without censorship. I wasn't held as close as that, but I know that I never went from one street to another without being dogged by spies, and every letter I wrote or received was read.

"Then came the line-up with Mexico and the war. I at once demanded a settlement and passports and they smiled and said: 'Certainly'—in Jap, you know. That night I was doped and the next day I woke up on board that ship out there—the *A atusa.*"

"What!" exploded the Admiral. "That vessel aground on the Chulavis Bar?"

Forsythe nodded as he drew into a spasm of recollection.

"Yes! Her Captain is a renegade 'No Country' man and the crew are the same. They are paid by the Japs to handle the Tentacles and they loaded sugar at Manila as a blind and then ran her in here with an alleged crippled engine and out her on the bar."

The Admiral turned to ne of his officers and growled hoarsely: "Go back to the ship, sir, and signal every vessel in the bay to train its guns on that *Aratusa.* Then take a party over in the launch and demand surrender. Instantly, Mr. Stevens!"

Forsythe's eyes gleamed and he went on: "The Japs had put me on board to see that the devilish things were handled right, and they tortured me into doing it. See that!"

He held up his hands, the thumbs of which were crushed and distorted out of any recognition if they hadn't been on the hands. Cawthorne ejaculated with horror: "Thumbscrews?"

Forsythe nodded. "They starved me at first when I refused to help them in any way. Then they used the screws and I had to give up—I had to! That Captain is a devil, incarnate, among devils as bad as himself!"

"That ship is driven by turbo-ger rators—that's why the Japs bought her. They can work up to twenty thousand volts if they want to. The winding is very peculiar, after the wonderful Haye-Abbot system, and the current it makes has action and qualities different to anything known before. You'll see all that if you get onto that ship."

"But how did they transmit it, Forsythe?" muttered the Admiral, impatiently.

"Tiny submarines!" groaned the man. "My special invention. They run out with a fine composite wire cable through which they are directed and through which that current is shot after they fasten onto their prey. They're not over four feet long and a man can carry one of them. In the head of each is an electro-magnet with pull enough to hold onto a steel hull. Then the high voltage Haye-Abbot current is switched in; runs through the vessel and back through the air, by wireless—the wonderful Swartson antenna, a bit developed."

He groaned in weakness and pain, but in a few moments he rallied and continued:

"You'll find 'em on board—all the stuff. That vessel has a double sheathing, you know; partly used for water ballast, and there's thirty of those Tentacles stowed away in those tanks. That's why the port authorities who came aboard after the accursed captain had run her aground didn't see anything suspicious. They didn't see me, anyway, for I was bound and gagged and stowed in one of those tanks."

He sank back on the cot, gasping. The doctor gave him some stimulant and presently he said:

"They ran her on the bar so that they'd have an excuse for running their engines. Claimed they had a bad leak and had to pump. When any outsiders came aboard

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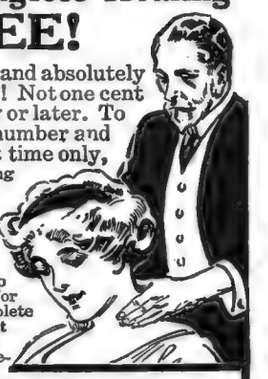

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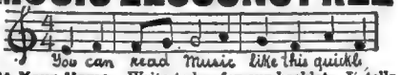

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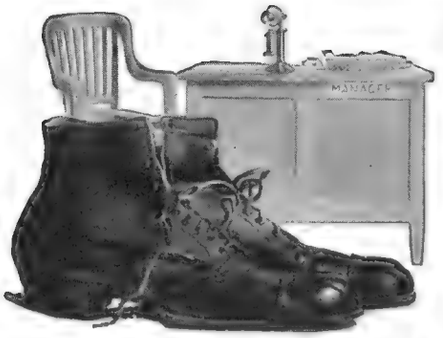

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they were operating pumps; when they were treating your vessels they were operating the generators. You couldn't tell out there, a mile or more away, what they were doing."

"How did you escape?" murmured Cawthorne, his voice and eyes filled with sympathy.

"It was last night, or sometime—I don't just know when. They were planning a night attack on one of your ships and I was forced to direct the adjustment of the little submerging tank of the Tentacle. They were slipping it overboard and I saw a chance to slip, too; and I did. I managed to swim through those breakers and got ashore, with a boat right behind me. Then I scrambled up to the shore road and just as an auto came along I fainted. Woke up here in the hospital."

The boom of a gun came from over the bay. The Admiral exclaimed: "My God! If they fire on that ship they'll destroy all that we ought to see. Come, gentlemen! We must go back."

A shot had been fired over the *Aratusa* as a demonstration of real business, but the launch sent over to take possession was not resisted in any way. The Captain and crew had taken to the boats and dashed ashore, and the Lieutenant went aboard a deserted ship.

* * * * * * * *

Everything was found as Forsythe had stated. In the tanks were stowed twenty-three of the curious little Tentacles, which on being opened and examined showed marvelously ingenious mechanism and just as marvelous workmanship. The salient feature was the control disc, which Kilroth instantly recognized as a perfection of Marvin's invention, but never before put into practical use.

In the report sent to Washington the description of the astounding Tentacles was briefly as follows:

"It is propelled by a moderate current through the attaching wire conductor, a marvel of strength and transmission qualities, but the composition of which has not yet been determined. The submerging tank holds the Tentacle at apparently any desired depth, and the aluminum floats attached to the conductor also holds that at the required depth, taking the weight off the Tentacle and requiring only traction power. A device of amazing electro-mechanism provides that if the wire conductor is broken at any point a clipper cuts that wire close to the Tentacle, and at the same time an inlet valve is opened into the submerging tank and the Tentacle sinks to the bottom of the ocean. This means that the discovery of any one of these Tentacles is avoided by the simple expedient of severing the wire at the tender—the *Aratusa*—and the Tentacle instantly sinks from any detection. The short length first discovered had been broken by some accident—probably contact with one of our submarines—and was instantly clipped off at the Tentacle, which now lies at the bottom of the bay.

The *Aratusa* must have sunk—perhaps to escape detection—seven of these Tentacles, in its week of operation in this bay, for Forsythe states that thirty were on board and only twenty-three remain. This man—the inventor—also states that the return of the current through the air was by special construction of the wireless telegraph antenna of the *Aratusa*, which received the return current from the smoke-stacks or fighting masts of the vessel that the Tentacle was attached to.

"It is respectfully suggested that an acknowledgment be made by the Naval Board, or by the President, of appreciation of the inventor, Forsythe's disclosure of this terribly effective weapon. His distress at his inadvertent work with the Japanese while they were on friendly terms with us, resulting in his tortured compulsion to continue that work against his own country, will surely result in death unless he is, in some way, comforted."

* * * * * * * *

THE MARVELS OF MODERN PHYSICS.

(*Continued from page* 556.)

the number in a stream of such particles and measuring the charge of the total number; then, by division, he obtained the charge of a single particle.

The late M. Curie and others believed that those particles in some way form an elemental magnet, which they have termed the *magneton*, and so the field, instead of being exhausted, is just opening up and scientists see ahead of them explanations of many of the old puzzling questions concerning electricity, light, matter and energy.

The foregoing experiments only serve to illustrate what is really happening in the scientific world and how progress is continual, though striking inventions may only come at intervals. Marvelous as the results already achieved seem, they are only the beginnings of greater marvels the future has in store for us.

RADIO AND ELECTRICAL ENGINEERS MEET AT 'FRISCO.

At the Panama-Pacific convention of the American Institute of Electrical Engineers, held at San Francisco, Cal., two of the sessions were joint sessions with the Institute of Radio Engineers. The first of these was held on Thursday afternoon, September 16, in the building of the Native Sons of the Golden West, R. B. Wolverton presiding.

A paper by Harris J. Ryan and Roland G. Marx, entitled "Sustained Radio-Frequency High-Voltage Discharges," was presented by Professor Ryan.

This paper described experiments made upon discharges in air at 60 cycles and at 88,000 and 188,000 cycles per second. The experiments included discharges from a single electrode, between a blunt point and plate, and the corona about a wire. Diagrams of the apparatus and photographs of the discharges were included. A sphere gap was used for measuring voltage. The ability of the radio-frequency brush to produce thermionic conduction through glass, porcelain, quartz, etc., was found to be its most remarkable property. The application of high voltage at high frequency to a porcelain insulator was found to produce hot conducting cores in the porcelain. No insulation supporting a conductor under such conditions can endure unless so designed that no air in contact with it is overstressed. The cyclograph was used to measure energy and power-factor. The following conclusions are reached:

Sustained radio-frequency corona brushes or flames once started are maintained at much lower voltages than those required to start them by overstressing and ionizing the atmosphere. They quickly destroy even the most refractory insulations by their heating and ionizing properties. The power-factor of the charging current of a conductor in corona due to the application of sustained radio-frequency high voltage is decidedly lower than the corresponding power-factor at low frequencies. Nevertheless, because of the high values of the currents that produce the radio-frequency coronas, the losses they cause may be hundreds of times the corresponding low-frequency losses.

THE WAR AND PROGRESS IN RADIOMECHANICS.

The war has led to a considerable development of radiomechanics. Among the things claimed for it is the ability to blow up the magazines of warships, to steer torpedoes in water, to drop torpedoes from airships and steer them to a goal on land, and to blow up bridges and fortresses.

To obtain a rational opinion on the question, the *Petit Parisien* asked for a statement from Prof. Branly. Prof. Branly, who is a Catholic priest, is known to scientists and students throughout the world. He is one of the men to whom the success of wireless telegraphy is due.

"It is possible to produce at a distance mechanical effort of any kind, but it is always necessary that the object to be affected be provided with apparatus receptive of electric waves. It would consequently be possible by means of radiomechanics to blow up at a distance a bridge or a fortress if the object to be destroyed were previously equipped for the purpose; that is, if it were fitted with a special apparatus. The consequent difficulties that supervene it would be superfluous to enumerate.

"As for operating from a distance torpedoes or submarines or dirigibles, which without crew or pilot should execute a work of destruction, that also would be possible. So far it has not been done in this war. It is obvious that an unexpected electric spark of atmospheric origin or coming from the enemy's side might provoke the action at a most inopportune time and in a most undesirable manner.

"In the field radiotelegraphy has proved itself most serviceable, as all know. The Germans make ample use of it. Their headquarters is thus united to Antwerp, to Brussels and to Lille. Radiotelegraphy was of great service to the 11 German warships which kept the sea for some months, doing a work of destruction. But it was also of service to the Allies for the discovery and destruction of those ships.

"As for the possibility of the enemy having on our territory hidden stations for radiomechanics, from which at a given time damage might be done, I doubt the utility of such a project. It would be easy enough to hide the antennae, but it would be impossible to hide the machinery," he intimated.

COLLEGE RADIO SET.

Prof. H. E. Robbins is at work on plans for installing a wireless telegraph station at the Agricultural College at Amherst, Mass. He has secured a 10,000-volt, three-quarter kilowatt transformer, crystal detector and head phones, and has applied for a room over the sophomore physics laboratory for the headquarters. He proposes to organize an intercollegiate radio club directly.

THE ELECTRIC ARC AND ITS INTERESTING APPLICATIONS.

(*Continued from page* 560.)

For the purposes of radio communication a smaller capacity and inductance should be used unless very high wave lengths are wanted. The inductance can be of the ordinary type oscilliation transformer, and variations in same can be made by means of clips.

Besides the uses enumerated above the arc has the very interesting property of being one of the chief factors requisite to the measurement of inductance and capacity, and is so used at the Bureau of Standards laboratories and elsewhere.

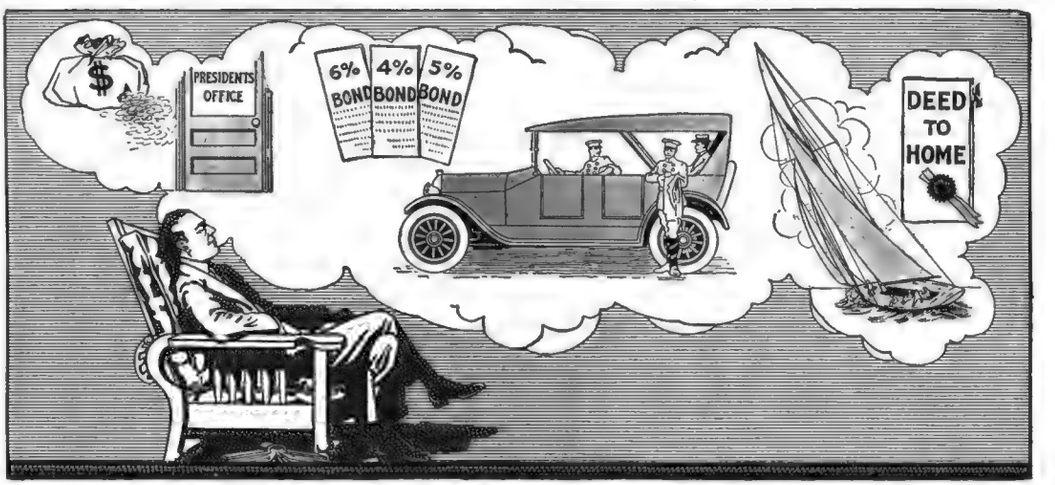
If at all possible for the experimenter to obtain the use of *direct current* it will certainly pay him to carry on investigations with this type of arc, as it will prove very interesting and instructive, and surely there is a large field for new discoveries.

Caution: When experimenting with the electric arc the eyes must be protected invariably by wearing "black" eyeglasses, procurable from any optician.

POPE TO BLESS WIRELESS.

The Exchange Telegraph Co.'s Rome correspondent says:

"Vatican circles announce that the Pope is preparing to bless wireless telegraphy officially, thus restoring the ancient custom of the Church to bless inventions which confer great benefits on humanity."



Partial Contents

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The Four Factors on which it depends.
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Detailed directions for Perfect Mind Concentration.
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How to drive from the mind all unwelcome thoughts.
How to follow any line of thought with keen, concentrated Power.
How to develop Reasoning Power.
How to handle the mind in Creative Thinking.
The Secret of Building Mind Power.
How the Will is made to act.
How to test your Will.
How a Strong Will is Master of Body.
What creates Human Power.
The Six Principles of Will Training.
Definite Methods for developing Will.
The NINETY-NINE METHODS for using Will-Power in the Conduct of Life.
Seven Principles of drill in Mental, Physical, Personal Power.
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How to develop a strong, keen gaze.
How to concentrate the eye upon what is before you—object, person, printed page, work.
How to become aware of Nerve Action.
How to keep the body well-poised.
How to open the Mind and Body for reception of incoming Power.
This is only a partial list—a complete list of contents would almost fill this page.

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The same is true of the Will. Because we don't use it, we don't know how. Most of us float along carrying out other people's wills simply because our own will has become scotched and dormant from lack of use. Yet the Will is just as susceptible to training as the brain or memory and by the very same methods, by intelligent exercise and use.

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by Frank Channing Haddock, Ph. D., a scientist whose name ranks with such leaders of thought as James, Bergson and Royce—is the first thorough course in Will training ever conceived. It is based on a most profound analysis of the Will in human beings. Yet every step in the 28 fascinating lessons is written so simply that anyone can understand them and apply the principles, methods and rules set down with noticeable results almost from the very start.

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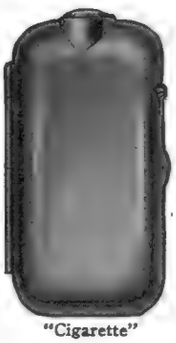

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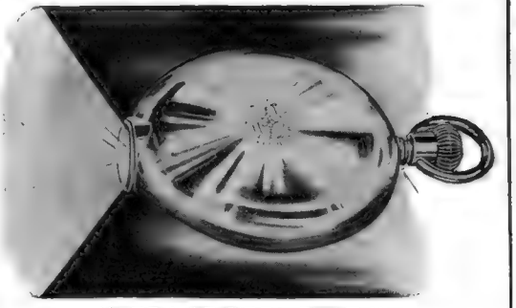

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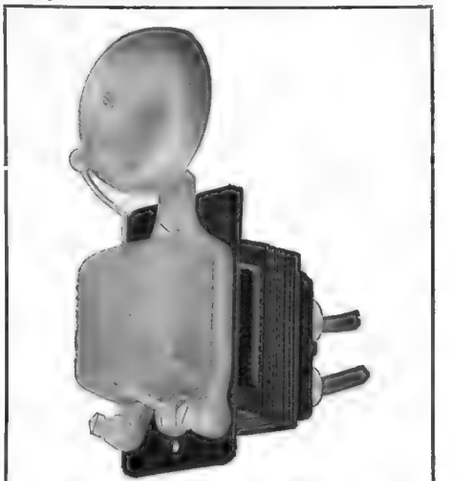

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UNIQUE ELECTRIC STOVE.

A very neat electric stove has recently been brought out by a Western manufacturer, as a glance at the illustration will confirm. It combines four functions in one; in other words, it can be used as a toaster, a griddle, a broiler and a stove. The manufacturers guarantee it for five years. It comes complete with drip pan or tray, and also with a toasting pan, which slides in under the heating grids, besides a frying pan, which is used on top.

Electric Stove of Many Uses.

BOOK REVIEW

WIRELESS TELEGRAPHY. By Dr. J. Zenneck. Translated from the German by A. E. Seelig, E.E. 443 pages; 469 illustrations; 6½x9½ inches. Cloth bound. Price, $4.00. 1915. McGraw-Hill Book Co., New York.

The latest acquisition to technical radio literature is here offered in this volume by Dr. Zenneck, the well-known wireless scientist. Much new matter is given in very attractive form of value to the general and advanced reader. A large number of important topics are covered mathematically and otherwise in an interesting manner. Some novel ideas are brought out on wave phenomena and particularly their propagation over the earth. The shape of the wave as it passes along the surface of the globe and the probable manner of overcoming such obstacles as hills, etc., is quite exhaustively treated upon. The author is an able authority on this subject and the reader will learn much by a perusal of this section as well as the very illuminating and lucid chapters on the natural oscillations of condenser circuits; open oscillators; coupled circuits; resonance curves; the antenna; undamped oscillations by the arc method; detectors; receiving circuits and their design; directive radio-telegraphy, etc., etc.

It is practically impossible to cover all the necessary laws and data on such a rapidly growing subject in a single volume, but this work is highly commendable in every way and should be read by all radio men. It seems as though the sections on arc type radio frequency generators, detectors, and high frequency alternators might have been advantageously extended. Some empirical deductions are cited in the chapter on "directive telegraphy" concerning the Marconi inverted "L" type antenna which seems somewhat far-fetched, in view of the fact that these antennae are in actual use by the Marconi Co., for long distance radio transmission over the Atlantic and Pacific oceans.

CHEMIST'S HANDBOOK. Issued by The International Correspondence Schools. Cloth covers; 5½x4¾ inches; 332 pages; 5 illustrations. Published by International Textbook Co., Scranton, Pa. Price, 50 cents.

The astounding part of this volume is the enormous amount of analytical data contained within its covers. It covers chemistry in a brief form and the tables are of use to every chemist, metallurgist or assayer.

The forepart of the book covers fundamental laws, atomic weights, chemical calculations and heat measurement. Analysis is handled in a masterful way with chapters on wet and dry analysis, assaying and blowpiping. The tables of results with different reagents are very valuable and blowpiping is covered in a manner that will be of assistance to anyone interested in this method of analysis and the tables of characteristic reaction cover 31 pages.

For the power plant engineer the subject of coal, boiler water and flue gas analysis is covered in a simple manner that assures the rapid and accurate calculation of the efficiency of steam plants.

TELEPHONE AND TELEGRAPH ENGINEER'S HANDBOOK. Issued by The International Correspondence Schools. Cloth covers; 5½x4¾ inches; 398 pages; 95 illustrations. Published by International Textbook Co., Scranton, Pa. Price, 50 cents.

A compact, reliable treatise on telephone and telegraph practise, the work of specialists in their line, and intended as a reference book for the practical man, aptly describes this little volume.

The aim of this treatise is to select, classify and place in the hands of the "man on the job" information and data that will be of practical assistance to him in his daily work.

The book starts with a brief treatment of mathematics, including various handy tables. Electrochemistry and mechanics are treated of so far as they bear any relation to the work of linemen, trouble-shooters or foremen. Wire tables and formula are given and the circuits in use are treated at length. The diagrams illustrating the latter are exceedingly clear and in many cases are full page drawings.

The latter part of the volume covers telegraph practise in a manner that will interest any telegraphist. A short treatise of wireless telegraphy is given, but this subject is rather briefly treated, only the general principles being given.

The book really gives a brief outline of the correspondence course on the subject by the I. C. S., but the volume will be invaluable to those in the least way interested in telephony or telegraphy.

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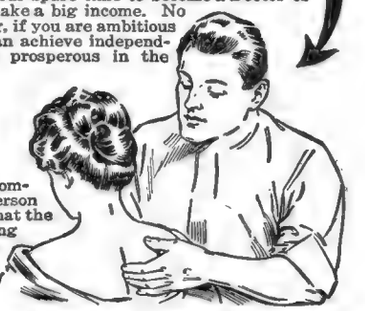

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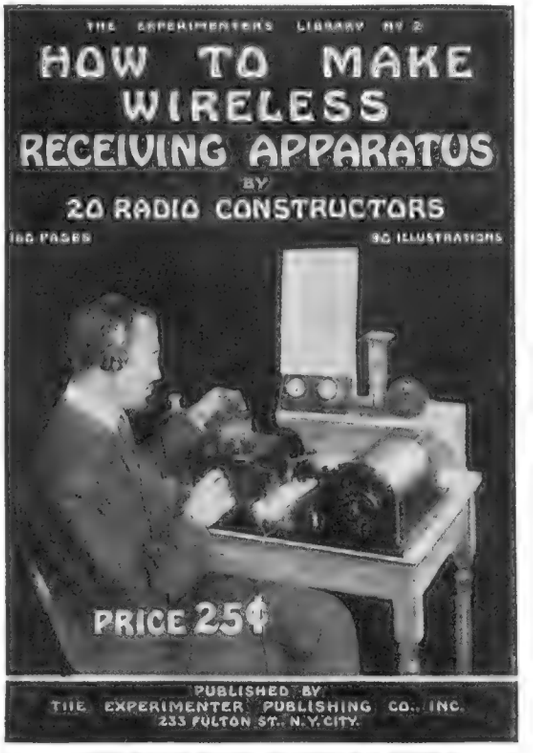

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WANTED—Back numbers of aeronautical magazines; also The Electrical Experimenter, Vol. 1. What have you? L. Koerner, 312 W. St. Vrain St., Colorado Springs, Col.

FOR EXCHANGE—Stamp collection in Scott's Best Album Cat., over $35. Want printing press, camera or electrical apparatus. Oscar E. Noreen, R4, Gresham, Ore.

FOR SALE—Two telegraph sounders, 50c. each; one electric car and outfit, cost $3, will sell for $1.50; two motors, 50c. each; telephone transmitter, 50c. H. Moershfelder, 34 Ketchum Pl., Buffalo, N. Y.

MOTION PICTURE FILMS, $1 reel up. Chas. Chaplin, etc. Will trade. If you mean business, write. Enclose stamp. Kenneth Woodward, 24 Lenox St., Uniontown, Pa.

FOR EXCHANGE—I have a complete ½ kilowatt sending set and an audion receiving set, complete, with necessary switches, aerial wire, insulators and two storage batteries; also lots of other electrical apparatus; complete value, one hundred and fifty dollars. Want a motorcycle, or will sell or exchange separately. What have you? Allan Lawson, 108 Walnut St., Waterbury, Conn.

WANTED—Any electrical or gas engines bought; good price. Kenneth Lee, Purcell, Okla.

HAVE 6-volt, 8-ampere D. C. Remy magneto in good condition; cost $10. Can be used as motor. Want good coil, 2 or 1½-inch, depending on make and condition. Kenneth Bard, Manawa, Wis.

WANTED—½ or ¼ K. W. transformer, audion bulb, good or broken, and spark gap. Will trade articles or pay cash. Would like to exchange photographs of stations. Alexander Bollerer, 77 Linwood St., New Britain, Conn.

FOR SALE—A Packard ½ K. W. transformer in oaken case, with power variations controlled by switch, and condenser for the same. Price, both together, $9. Wm. Bride, 116 E. Haverhill St., Lawrence, Mass.

ONE radio 3,000-meter loose coupler, galena, two Universal electrolytic detectors, rotary potentiometer, two 43-plate variables, $10, cost $24. Claxton horn, Stewart speedometer, motorcycle electric lamp, $7, cost $20. Sold separately. Want 3,000 phones, audion detector or bulb, ½ K. W. closed-core sending instruments. H. Hawks, Fleming, Pa.

HAVE telegraph key sounder and about 50 feet of wire to exchange. What have you? M. R. Heslowitz, 151 Peshine Ave., Newark, N. J.

FOR SALE—Edison kinetoscope; also ¼ H. P., A. C. 110-volt electric motor, fluoroscope X-ray tube and centrifuge. H. S. Partee, Biddle University, Charlotte, N. C.

HAVE a motor bike engine, .22 Savage high-power rifle, piano player, single Merkel motorcycle, stereopticon and other articles to exchange for a 2 K. W. 110-volt generator, small lathe, electrical experimental articles. H. A. Margreiter, LaPlata, Mo.

MURDOCK APPARATUS—Loose coupler, $6; loading inductance, $2; detector with condenser in base, $1.50; Blitzen variable condensers, 43 plates, $3; 31 plates, $3.50; all equal to new. Sent P. P. C. O. D. Wm. Ranft, 4107 Belle Ave., Baltimore, Md.

FOR SALE—Type "S" dynamo motor, $1.50; in good condition. Letters answered. Ernest Becker, Isleta, O.

FOR SALE—Blitzen receiving cabinet set; hand bench punch, weight 130 lbs.; metal splitting shear, weight 100 lbs. Write for particulars. C. F. Lee, 1417 Belleplain Ave., Chicago, Ill.

"ARLINGTON" receiving set, only $6, mounted ready for use; gets Arlington loud with small aerial. Send for photo and description. A. Newman, 685 W. Ferry, Buffalo, N. Y.

FOR SALE OR TRADE—Books on adventure, etc. Clean, live and wholesome. Make me at least an offer. For particulars write Chas. Hrdlicka, Lesterville, S. D.

EXCHANGE—Meccano outfit No. 4, $6 motor, high-grade radiopticon and 4 H. P. motorcycle engine. Want wireless apparatus. E. W. Pennington, 3236 Stevens Ave., Minneapolis, Minn.

WANTED—A cabinet receiving set in exchange for moving picture machine, no toy. Have three violins, guitar and xylophone. What have you in the receiving line? Harold Buckner, Morgan Hill, Cal.

FOR SALE—Complete loose-coupled wireless receiving outfit, standard amateur type, including aerial, ground and connecting wire and accessories. Cost $12; will sell for $6. Write for description. H. Frankland, 517 W. 113th St., New York.

EXCHANGE—Set of five electrical books, two-point annunciator, wall telephone and other goods. J. Forsht, Box 861, Lock Haven, Pa.

EXCHANGE—Bass violin 6 feet tall, best condition, except strings, for wireless sending set. B. J. Morrison, Cherryville, N. C.

FOR SALE, Twenty dollars, or separately: Mignon coupler, three thousand ohm telephones, load, fixed and variable condensers, eight Electrose insulators, six mineral detectors, minerals and switches. Meeker, 511 W. 186th St., New York.

FOR SALE—One Eastman No. 3A Brownie and complete outfit in good condition, with developing tank. First money order for $10 takes it. Chester Ickes, Reynolds Dale, Pa.

BIPLANE GLIDER—Upper plane, 24x4½; lower, 20x4½; length 16 ft. New, worth about $60. Will exchange for wireless goods, cyclecar, motorcycle or motor. H. W. Craver, 222 Custer Ave., Youngstown, O.

WANTED—Burnt-out audion bulb; will pay $1.50. Charles Bunker, 114 E. Carter Ave., Ashland, Ky.

FOR SALE cheap, in good condition: Loose coupler, potentiometer, electrolytic detector, single-pole, thousand-ohm receiver and cord. Write Wm. W. Macalpine, 5845 Phillips Ave., Pittsburgh, Pa.

WANTED—A pair of two or three thousand ohm phones and headband. Harry R. Fees, Guthrie, Okla.

FOR SALE—An engine and coal car 2 feet long, three cars measuring 15 inches each, 19 feet of 2½-inch track, two switches; all cost $40. Will sell for $20. All in perfect condition; selling because interested in wireless. Holden Booth, 3529 Ainslie St., Philadelphia, Pa.

BARGAINS—Nar meter loose coupler, $3.50; American Model Builder No. 6, $7.50. Want ½ K. W. closed-core transformer, rotary gap. All letters answered by Carl Linxweiler, 140 Eagle St., Dayton, O.

TRADE—Type "SS" Knapp dynamo-motor and small medical coil; both in good condition. Want burnt-out audion globe and two sockets for same. Write Tom Sides, P. O. Box 375, Selma, Cal.

FOR EXCHANGE—Rhumkorff ¼-inch spark coil of mahogany woodwork, cost $6 when new, for a good audion bulb. Joseph Terleph, Brown Ave., Jamaica, L. I.

FOR SALE—One 2¾ H. P. Indian engine, $9; one 3 H. P. boiler and engine, including all gauges and governor, with sufficient new pipe fittings to install, $20. Will exchange one 2 H. P. 220-volt D. C. motor, less field coils, for typewriter. Send stamp for particulars. Gregory Fay, 1024 Bellevue Ave., Syracuse, N. Y.

FOR TRADE—Series telephone and telephone parts, magic lantern with five hundred views, musical instruments. Exchange for Omnigraph, tape register, or what have you? S. H. Rudy, R. F. D. No. 4, Fairmont, W. Va.

FOR SALE OR EXCHANGE—Complete wireless receiving or sending apparatus, worth $49.50, for $20 cash; or separate parts sold for one-third price. Send stamped envelope for reply. Write at once. Robert Roth, 2023 Evergreen Ave., Chicago, Ill.

SPECIAL NOTICE—Will sell my Electrical Engineering books, civil, chemical and two $10 medical books, magazines on electricity, such as Electroforce, for what you can offer. Write or send 50c. for samples. Robert Roth, 2023 Evergreen Ave., Chicago, Ill.

BARGAIN! Complete wireless outfit (new), cost $50; will sell for $30 if taken at once. Also have printing press for $2; catcher's mitt, with league, for $3. For particulars write Fred Roewekamp, 202 Wangoo St., Oshkosh, Wis.

FOR SALE—New 2-inch coil, $5.75; Brandes Superior phones, $4; gas postcard projector, cost $5, will sell for $2.50. H. Moershfelder, 34 Ketchum Pl., Buffalo, N. Y.

FOR SALE—12-inch fan, D. C., 1-6 H. P.; $4 takes it. Two-cylinder spark coil (French make), $5. Manuel Rattner & Bro., 36-38 Union St., Poughkeepsie, N. Y.

FOR SALE—½ K. W. induction coil with vibrator, $4.50; ½ K. W. helix, $2.50; and a receiving transformer, tunes up to 3,500 meters, $2.50; five cells Exide storage battery, $30. R. J. Freeman, Aloah Radio Sta., Southampton, N. Y.

FOR SALE—Electro transcontinental receiving set No. 1603, with 3,000-ohm phones, aerial wire, insulators, lead-in cable, wireless course, etc. Cost $33; never been used; $25 takes it. A. G. Afton, 521 Ash St., Osage, Ia.

FOR EXCHANGE—Lionel train, two reels of film, 180-ohm relay, Brownie camera, 110-volt motor and rheostat, ½ H. P. Would like any of the following: Audion, variable rotary condenser, headset. What have you? A. H. Dreesner, 89 Dorman St., New Haven, Conn.

FOR SALE—Rotary gap disc, $1.25; Electro wireless course book form, 50c.; Rex motor, 40c. Rudolph Wensko, 2146 W. 81st St., Cleveland, O.

LOOSE COUPLER—Tunes to 2,000 meters, woodwork solid oak, primary and secondary varied by switches, $6, express paid. Also a 1,000-meter loading coil, woodwork solid mahogany, $2.25, prepaid. W. H. Ritter, 2748 N. 22d St., Kansas City, Kan.

EXCHANGE—I. C. S. electric lighting course and first-class drawing outfit, complete. Want 2-inch spark coil, Tesla coil or other experimental or wireless goods. Edward Olson, R. No. 1, Mt. Vernon, Wash.

WOULD LIKE to exchange a 110-volt, three-speed direct-current General Electric fan, worth $15; a medical coil, $3.50; Knapp electric question board, $2.50; a $15 boy scout snare drum; $5 Erector building set. Would like wireless apparatus, or I prefer a large electric train and equipment. Arthur Vernier, 34 Beecher Ave., Detroit, Mich.

$6 takes inductive coupler in hard rubber cabinet, coupling and turns varied by knobs. Want two 43-plate variables. Francis Pray, 102 Heath St., Somerville, Mass.

SELL OR EXCHANGE—Thordarson step-down transformer, bargain, $3.25; Brandes 2,000-ohm phones, $3.50; loose coupler, 3,000 meters, $2; volt-ammeter, new, 90c.; Mesco beginner's outfit, 85c. Other wireless apparatus and electrical books for sale. E. Braatz, Lowellville, O.

FOR SALE at a bargain: Nichols Gem set, detector, single-slide coil, Electrose insulators, carbide lamp. Electro fixed variable condenser, transmitting wave-reducing condenser and four-strand antenium aerial wire; all practically new. Make me offers. John A. Irvin, Cannelton, Ind.

BARGAIN — Perfect four-miler, Bunnell one-inch coil, zinc gap, Gernsback interrupter, fuse block, Victor key, two-glass plate condenser, D. P. D. T. switch; all $5.50. Receiving 1,500 miles. Bornite and zincite detector, Bunnell 500-ohm receiver, three-slide tuner, two fixed condensers, three antenna insulators, switches and sundries; all $2.75. Money order or cash, either or both shipped. R. W. Howe, 1120 Amsterdam Ave., New York.

HAVE 8 H. P. gasoline engine complete, 4 H. P. Gray marine engine, complete, with salt water fittings, never uncrated or used, and other apparatus. Want audion, automatic pistol, transformer, camera, anything electrical or wireless, or cash. Make offers. Send stamp. Clyde P. DeLancey, Box 71, Hampton, N. H.

FOR SALE—Several numbers "Electrical Experimenter," "World's Advance," "Modern Mechanics," "Popular Electricity and Modern Mechanics," one Morgan's "Wireless Telegraph Construction for Amateurs" and three handbooks; all going cheap. H. Frankland, 517 W. 113th St., New York City.

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by Erardus Sagra, who tells how he avoids loss and succeeds in receiving large returns for the investment of comparatively small sums of money in honorable and safe enterprises. His valuable experience, for which he charges $1 (by money order or registered letter; no stamps accepted) will save you quite a little fortune if you have a little patience. Satisfaction guaranteed or money refunded. Erardus Sagra is also the author of "The Might of Truth," the price of which is $1 net; but temporarily it has been introduced at the nominal price of only 24c. This interesting book is FREE to all who order the above mentioned "Warnings and Advice to the Small Investor." Those who purchased this book already at the nominal price need not send more than 75c. (It will take from three to four days to fill your order.) Address M. T. Dept., Box 2034, Middle City Station, Philadelphia, Pa.

HAVE you seen a copy? Amateur Photographers' Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 25c. Amateur Photographers' Weekly, 915 Schofield Bldg., Cleveland, O.

MISCELLANEOUS

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GALENA detector No. 35, 35c.; complete parts, 25c. Postage, either, 5c. Fixed receiving condenser, 75c. Walter Patch Co., Klemme, Ia.

SPECIAL—65c. detector, 40c. receiving condenser, 4 ounces silicon, all carefully tested on Arlington, $1.25, postpaid. Silicon carefully tested on Arlington, 15c. an ounce, postpaid. Lloyd Gress, Pitman, N. J.

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$10 COMMERCIAL KEYS for $4. Money refunded if not satisfied. Massie Wireless Telegraph Co., 77 Washington St., Providence, R. I.

(WIRELESS)—Bargains in new wireless goods. Circulars for stamp. Imperial Electric Co., 82 Wallabout St., Brooklyn, N. Y.

2,500 METER loose couplers, $5; other wireless bargains. Send for circulars. Cliff Mfg. Co., Brookfield, Mass.

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Complete Double Set

2000 Ohms - - $4.00
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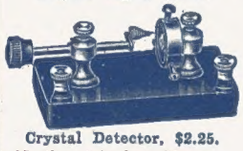

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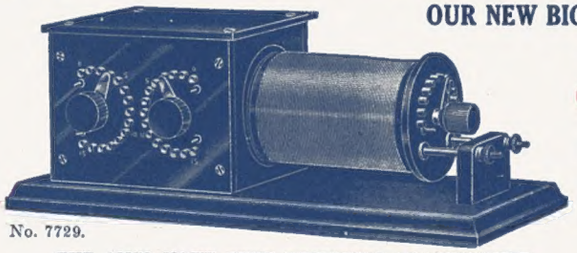

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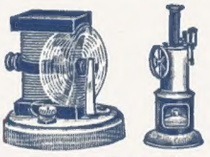

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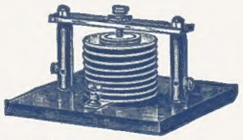

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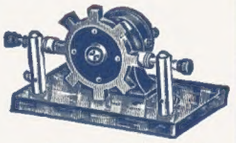

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